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THE

Mineral Resources

OF THE

Dominion of Canada,

Comprising the Provinces of

PRINCE EDWARD ISLAND, NOVA SCOTIA, NEW BRUNSWICK, QUEBEC, ONTARIO, MANITOBA, BRITISH COLUMBIA AND THE NORTH-WEST TERRITORIES.

Specially adapted for

Emigrants, Capitalists and Settlers.

Ottawa:

1882.

MINERAL RESOURCES

OF THE

DOMINION OF CANADA:

COMPRISING THE PROVINCES

OF

PRINCE EDWARD ISLAND,
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NEW BRUNSWICK,
QUEBEC, ONTARIO,
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BRITISH COLUMBIA,
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Entered according to Act of Parliament, in the year one thousand eight hundred and eighty-two, in the office of the Minister of Agriculture, at the City of Ottawa.

PREFACE.

THE continually increasing demand, both from abroad and at home, for reliable information respecting the mineral resources of the Dominion, and the entire absence of any concise hand-book on the subject, has suggested the compilation of this Pamphlet from official sources and reports.

To intending Immigrants, Settlers and Capitalists it cannot fail to be of the greatest service, as the localities of the minerals are given by Provinces, and are so arranged as to afford easy reference to any particular mineral at once.

The Geology of Canada published by Government some years ago is now hardly procurable, and, from its voluminous form, is not so available for concise information as a smaller work. In this Handbook conciseness is aimed at for purposes of reference, with a due regard to such details as may prove serviceable to inquirers.

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THE

MINERAL RESOURCES

OF THE

DOMINION OF CANADA.

THE possession of metals is of vital importance to every country, and nature has been extremely prolific in giving Canada, in its varied geological formations, many of the ordinary metals and ores. To quote the words of Lanman, a well known American writer, "to particularize the undeveloped wealth of this northern land would require volumes." The Atlantic coast embraces a large area of the oldest known formation, the Laurentian, which brings up from the bowels of the earth, either in its rocks or accompanying them, nearly all the known minerals. The Pacific coast, over an area of several hundred thousand square miles, is composed of rocks similar to those of Colorado and Nevada—the bonanza bearing rocks. The district between the great lakes, while apparently without the precious metals, furnishes no small amount of other minerals, of which also the Prairie regions contribute their share.

The attention of capitalists, both native and foreign, which has within the past few years been attracted hither, has had the effect of eliciting facts which prove beyond a doubt that Canada is destined eventually to rank as one of the finest mining districts in the world. The impetus lately given to prospecting by inquiries constantly being made has caused the discovery of important deposits of economic minerals of vast extent, and of so varied and useful a character—the existence of which in Canada was previously unknown, or, at least, known only to the geologist and man of scientific pursuits —as to, in many cases, lead to the rapid development of new

resources of industry. The system of scientific exploration and analysis afforded by the annual progress of the Government Geological Survey is gradually unfolding the hidden wealth of the mines, and private enterprise is doing much towards this end. The drawback hitherto experienced has been in the fact that sufficient capital has not been applied to the development of the general mineral wealth to make it productive, and it has not unfrequently happened that many mining operations were only of a speculative character, the effect of which was to throw doubts on all mining schemes. But foreign capital is now being brought in, and has wrought a wondrous change. As the mineral resources of this country become developed, its agricultural capabilities will be fully brought out, manufactures and commerce will increase, and a numerous and thriving population will find ready employment in the various branches of trade.

The chief minerals of economic importance enumerated in the Geological Survey Reports as existing in Canada may be thus classed :—

1. Metals and their ores.
2. Minerals applicable to chemical manufactures.
3. Minerals applicable to construction.
4. Minerals for grinding and polishing.
5. Minerals applicable to refraction.
6. Minerals applicable to the Fine Arts.
7. Minerals applicable to miscellaneous uses.

Metals and their Ores.—Under this head are the following : Iron, which exists as bog ore, hematite, magnetic and specular ore and magnetic iron sand ; lead; copper, sulphurets and native ; nickel and cobalt, zinc, silver, gold, platinum.

Minerals Applicable to Chemical Manufactures.—Iron ores and chromic iron, sulphate of barytes, molybdenite, cobaltiferous and arsenical pyrites, bismuth, antimony, manganese, dolomite, magnesite, phosphate of lime and calcareous tufa. Of the above, iron ores and sulphates of barytes, chromic iron, bismuth and others are used as pigments and in the manufacture of paints ; molybdenite and manganese for bleaching and decolourizing ; pyrites for the manufacture of copperas, sulphur and sulphuric acid ; dolomite and magnesite for medicinal purposes ; phosphate of lime and calcareous tufa for artificial manures.

Minerals applicable to construction.—Under this head are limestones and sandstones for building purposes, the former is also used to prepare lime and hydraulic cement ; gneiss ; syenite and granite

for paving purposes; marbles, found in great variety, white, black, red, veined, dark and light green, brown, grey, mottled, etc., for pillars mantlepieces, and decorative purposes and sculpture; slates for roofing; flagstones; clays, various colours, for bricks and tiles.

Minerals for grinding and polishing.—Whetstones, hones, grindstones, millstones, and emery powder.

Minerals applicable for refraction.—Asbestos, or amianthus; mica; soapstone, or stearite; plumbago, or graphite; and clay for fire bricks.

Minerals applicable to Fine Arts.—Lithographic stones, agates, jaspars, crystals, amethysts.

Miscellaneous minerals.—Coal, lignite, rock salt, petroleum or rock oil, feldspar, bituminous shale.

IRON.

There is no other metal of so much importance in the material progress and prosperity of any country as iron. Its use seems to have been unknown to the Indians, probably from the difficulty of bringing it to a state fit for use, and from the greater ease with which more malleable metals could be wrought. This metal is found in great abundance and variety in all the Provinces of the Dominion. Manitoba, as it originally existed, contained no minerals; but since the extension of its boundaries eastward it embraces mineral deposits in that new portion of the Province. Most of the localities where important discoveries of iron have been made are fortunately situated on or near the banks of navigable waters, and the ore occurs generally near the surface. A New York writer, in calling attention to the vast number of iron deposits in Canada, says there is every probability of a heavy rivalry between Canada and the United States in the manufacture of this metal, not only on account of the remarkably excellent quality of the Canadian metal, but on account of the low prices of labour and material employed here in its production; and the writer exemplifies its quality from a test made by the Superintendent of the West Point foundry, who reports a square inch of Canadian iron resisting 20,000 lbs. more pressure than that from the most popular works in the United States. The same iron, he says, has been manufactured into beautiful specimens of steel.

Ontario.—The principal localities in Ontario where iron exists and where it is worked are on the northern shores of Lakes Superior and Huron, at Bachewanung Bay, Gros Cap, Michipicoten, the ore in these localities often being interbedded with jaspar.

Silver Lake mining location, Thunder Bay, is thus officially described : " The ore occurs in a group of beds not less than forty or fifty feet in thickness, associated with compact sandstone and ferruginous limestone suitable for a flux, near the base ot the Nepigon series, and very favourably situated for mining and smelting with charcoal."

Loon Lake, Thunder Bay.—" Deposit of considerable extent, and running north-westward from the head of Thunder Bay."

Desert Lake, near Bruce Mines.—" A solid vein three feet thick, which in one place shows to great advantage for mining, at an elevation of two hundred feet over Desert Lake, which connects by a navigable river with Lake Huron. This ore contains 56 per cent. of iron and no appreciable quantity of sulphur or phosphorus."

Killarney.—" The main vein about twenty feet in thickness, of solid ore, and situated conveniently for shipping on the west side of a bay of Lake Huron."

In the eastern district of Ontario, back of Belleville and Kingston, and situated between Lake Ontario and the upper waters of the Ottawa River, iron is met with abundantly, extending through the townships of Marmora, Hastings, Tudor, Madoc, Bedford, etc. The mines of this district have gone through various fluctuations ; access to them is easy by means of the Toronto and Nipissing R.R. and the Cobourg and Peterboro' and Midland R.R.; these lines also materially aid in bringing the ore down to Lake Ontario for shipment to Cleveland for smelting. At Snowdon, Peterboro', the beds have a possible aggregate thickness of 50 or 60 feet. At Blairton, Marmora, is one of the most important deposits of magnetite in Canada; ore is now being raised there from a depth of 160 feet. The mining and loading on the cars of the Cobourg and Peterboro' R.R., which takes it to Rice Lake only, costs $1.25 per ton. Some years ago a blast furnace was erected near these mines to smelt the ore with charcoal, but, from various causes, it was not successful.

At Seymour, Madoc, in 1837 a blast furnace was in operation for a short time, but abandoned, and the iron produced is said to have been of very superior quality. The Neilson Mine is a continuation of the Seymour beds, " it is rich in iron, but contains a good deal of pyrites." The Cooke Mine yields ore which resembles that of the Seymour bed." The Moore Mine is " very free from impurities; said to contain about 61 per cent. of iron." The Foley Mine, Bathurst, "yields to analysis about 58 per cent. of iron." The Glendo-

wen or Howse Mines, Bedford, "situated about two and a half miles from the Kingston and Pembroke R.R., seventeen from the Rideau Canal, and about 20 north of Kingston, on Lake Ontario. These mines are worked by a company at Elmira, N. Y. State, to which place the ore is shipped. The Machar Mines, Bedford; Silver Lake Mines, South Sherbrooke, are recently opened. Chaffey Mines, Newburg, are "situated on an island in Mud Lake, the ore said to be about 200 feet thick; an extra vein of the same bed occurs on the mainland, where it is worked and known as the Matthews Mine. At the Dalhousie or Cowan Mine, near the the Town of Perth, the ore is very free from deleterious constituents, and contains an average of 60 per cent. of iron. In the township of McNab there is a deposit thirty feet thick on the surface "of excellent quality." These are some of the principal mines opened in Eastern Ontario.

Bog iron ores are of common occurrence in the Province, more especially in the sandy tracts which flank the Laurentian Hills. Sometimes they exist pulverized, and are then known as ochres, and better adapted for pigments than for smelting. No ore is more easily reduced than bog ore, as it is not only porous but the organic matter it contains undoubtedly aids in its reduction. Wrought iron can be easily made from it by means of the Catalan Forge, with the expenditure of very little capital, where there is a slight water power and where hardwood, such as birch, etc., is abundant. A deposit of black iron sand at the outlet of Lake Huron near Sarnia, attracted some attention a few years ago, and along the north shore of Lake Erie it is so abundant in places that attempts were made at one time to collect and smelt it with an admixture of the bog ore at Normandale. At this latter place, eleven miles from Simcoe, a blast furnace was some time ago erected to smelt the bog iron of the neighbouring Township of Charlotte, but it has been for some time unused, and is now in ruins. Capital would be well employed to resuscitate this industry.

Quebec.—Magnetic iron is found more or less all through the Laurentian chain of mountains traversing the north side of the Ottawa River; but the only place where this mineral is worked is in the County of Ottawa, within a short distance of the Capital. The Hull or Baldwin Mine, some two miles west of the Gatineau River, has been in operation some years, and the quantity of ore at that point may be said to be unlimited. In enlarging the bed at the entrance to the mine, situated on elevated ground and approached not from above but from below, thus obviating the labour and expense of underground working, large veins have been struck to the right and left, and dipping at every imaginable angle.

Immense blocks of ore here and there protrude from the hillside. Roughly estimated, the cubic contents of this hill are 288,000 tons of surface ore, whilst the amount of accessible mineral has been estimated at 100,000,000 tons. The veins, having their inclination downward, show an increasing richness the deeper they are explored. A careful analysis made in Boston gives 67 per cent. of metallic iron.

The Haycock Mine, situated in the Townships of Templeton and Hull, is stated in the Geological Survey Reports to be the only known workable deposit of *specular* or *hematite* ore in the Laurentian rocks of Canada. Its location comprises a compact area of 300 acres of mineral land some 8 miles north-east of Ottawa City. Analyses of the ore show from 64 to 68 per cent. of the metal, and when prepared it compares favourably with the finest Sheffield steel. The mine is worked by the Ottawa Iron and Steel Manufacturing Company. A number of deposits or beds exist on the property, some showing a thickness of several feet, and large blocks of ore weighing 4 or 5 tons have been taken from these. Professor Chapman estimates the amount of ore workable on this property at 6,300,000 tons, or a daily output of 100 tons of ore, or 60 tons of metal, during a period of a century and a half, and has no doubt that other equally rich beds are contiguous and available. This mine promises to be the most valuable of its kind in Quebec.

In the district lying between Lake Temiscamingue and Lake St. John magnetic iron and magnetic iron pyrites exist.

The metamorphic rocks of the Eastern Townships occasionally contain deposits of magnetic iron, viz.: Leeds (Megantic), and in Inverness. In the Seigniory of St. Francis, Beauce, a bed of granular ore occurs 45 feet wide. Few of them appear to be of much economic importance, and are unworked. At Baie St. Paul, St. Jerome, St. Julien near St. Lin, Bay of Seven Islands, Brome and Sutton, titanic iron ore exists. At Moisie River, on the north shore of the Gulf of St. Lawrence, occur deposits of remarkably rich magnetic iron sand, from which the finest steel can be manufactured. This sand yields fully 60 per cent. of reheated and rehammered malleable iron. Similar deposits exist at Bersimis and Mingan and in places along the shores of the lakes in the interior lying back from the coast. They also stretch along the coast from Bay of Seven Islands to the Moisie River, and are favourably situated for loading vessels.

The source of the sand which overlies the old marine clays is traceable to the disintegration of the crystalline rocks, and the separation of the lighter from the heavier particles, effected by the action of the sea under the influence of

storms and tides. The result of this action causes remarkable accumulations of these sands at certain points along the beach. These stratified sands are observed to be banded by irregular dark coloured layers, in which the iron predominates. This is due to the action of the waves, which effect a process of concentration on a grand scale, so that after the prevalence of certain winds great belts of nearly pure black sand are exposed along the shore. When the works at Moisie were being carried on, the supplies of sand ore were obtained from below high water mark; and the poorer sand from above, when spread on the shore and exposed to the action of the waves, soon became concentrated through the washing away of silicious grains, and equal to the other deposits. The quality of the Moisie iron is very superior. The results of experiments made upon it in England showed a tensile strength greater than that of Lowmoor iron, and to work easily, both hot and cold. This excellence is attributed to an almost entire absence of sulphur and phosphorus in this ore.

Large quantities of bog iron ore are found in the district of Three Rivers, and of a remarkably excellent quality. At the St. Maurice forges, near Three Rivers, large quantities of iron are turned out from this source. These forges or foundries are smelting works on a small scale, were established by the French in 1737, and are interesting as a monument to the enterprise of the early settlers of that region. Nearly all the iron produced is sent to Montreal, where it is manufactured into car wheels, though formerly castings were made on the spot. Wrought iron is manufactured on a small scale in a hearth finery, and used in the manufacture of axes, which have acquired a great reputation among the lumbermen, and the demand is far ahead of the production. At the conquest of Quebec, the right of the French King to a royalty on the products devolved on His Britannic Majesty. Other furnaces for this ore exist at Radnor and L'Islet and St. Francis, Yamaska County.

New Brunswick.—Iron of good quality is abundant over a large part of the northern and north-eastern portions of the County of Carleton, traceable from the Aroostook region, in the State of Maine, to the St. John River, and eastwards of the latter for a distance of 15 or 20 miles. The principal locality from which the ore has been removed is in Jacksontown, near Woodstock. Most of the bed here is hematite, but bog iron ore is also met with interstratified with clay slates. A blast furnace was erected at Woodstock some years ago, but has never been in continuous operation, working only at intervals. It has, however, again been put in operation, and some 40,000 tons have been smelted; but as analyses of the ores

indicate a proportion of phosphoric acid the production of a metal of superior quality seems doubtful. Bog iron ore is found in alluvium overlying the rocks of the coal measures in Queen's, Sunbury and York, as well as in various parts of Charlotte, Restigouche and Northumberland Counties, where surface indications point to large deposits, especially in near proximity to the line of the Intercolonial Railway. Few attempts have been made to work or smelt these deposits until lately, although they cover large areas, and in one locality are known to attain a thickness of from four to five feet. An analysis of the ore from Sunbury County yielded 47 per cent. of metal. Bog iron is raised for the Woodstock works on the Banks Farm, four miles below Woodstock, on the east side of the St. John River, where it is roasted on the spot, and the calcined ore then transported to the works by rail.

Nova Scotia.—Iron ore, though known to exist in one form or another in every part of this Province, and of extreme purity, has not received attention commensurate with its presence, especially when the important fact is considered that in Nova Scotia alone of all the Provinces the fuel, fluxes and ore occur close together, and the ore beds are generally easy of access near water or railway transport. There are only two mines in operation with the concomitant establishments for the reduction and treatment of the ore. These are the Acadia, at Londonderry, in Colchester County, and the Iron and Coal Mining Company, at Annapolis County. At this place the ore is found in two beds known as the Milner and Potter, the former yielding 33 per cent. of metallic iron, and the other still more. At Nictaux there are several distinct and parallel beds of iron ore, from 4 to 10 feet wide, extending five miles continuously. The iron beds of the Cleveland Mountain, Lawrencetown, Aylesford and Meadowvale are reported rich; at Gordon, between Windsor and Truro, a vein 40 feet wide has been opened, yielding 35 per cent. of metallic iron. At Brookfield, ten miles south of Truro, are extensive surface indications, reporting on which an engineer of repute stated he considered the indications of an extensive deposit greater than even at Londonderry mines. An analysis by Dr. Howe, of King's College, gives 60 per cent. of metallic iron.

At the Cobequid Hills, which mark the division between the watershed dividing the streams flowing into Northumberland Strait from those flowing into the Minas Basin and Channel, the Steel Company of Canada hold 55 square miles of territory, and the ores are known to extend over 25 miles to the west of the lands controlled by this Company. The analyses of ores taken from various points in this property give a percentage in limonite of from 48 to 56 of

metallic iron, and in the specular 67 per cent. The works of the company are situated at Londonderry, within a few miles of the Intercolonial Railway, and connected with it by a branch ; and in addition to the railway connections there is a convenient shipping place on the Bay of Fundy, a few miles below the works. Pictou County, from the abundance of ore, coal as fuel, and limestone as flux, bids fair to play an important part in the iron producing interests of this Province. Years ago a blast furnace was operated at one of the Pictou collieries, but the cost of hauling the ore from a distance put an end to the work. At Sutherland's Brook the Pictou Coal and Iron Company hold a large deposit of spathic iron ; along the Earl River, up from Springville, there exist deposits of limonite on the property of the Halifax Company having a thickness of 21 feet, and another on the Saddler area of the Pictou Company of 15 feet. They yield a return of 65 per cent. of metallic iron. On the St. Mary River large beds of limonite exist, and at Arisaig a bed of hematite three feet thick has been found. In Cape Breton very little has yet been done in the way of working the yield of iron. At Big Pond, East Bay, Bras D'or Lake, is a large deposit of ochreous red hematite of excellent quality. At the crossing of the French Vale and Bourinot Roads, 17 miles from Sydney, is a valuable deposit of red hematite ; also at St. Andrew's Channel, George's River and Bourlarderie.

At Whyhogomah, on Bras D'or Lake, the Inverness Company own nine deposits of a mixture of red hematite and magnetic iron. Limonite has been discovered at Newton Mills, West Branch Lake, Green Hill, Walton and Lake Ainslie. Hematite is found at Merigonish, Grand Anse and Gabarus ; magnetic at Cape St. Lawrence. From Canso to Yarmouth, beds and veins of iron occur, and at the junction of the carboniferous rocks with other strata, valuable deposits generally exist. Iron sand is found at St. Mary's Bay, west of Digby, in bands of irregular extent on the beach. It is also reported existing at Shelburne, on the Atlantic coast, and at Musquodoboit, near Halifax. Bog iron ore is found scattered in all parts of the Province; few of the beds, however, have been tested, but its existence is ascertained in quantities sufficient for mixture with other iron ore if required. At Bloomfield a blast furnace for smelting it has been running at intervals; at Nictaux a furnace formerly existed to work similar ore found in the vicinity. A superior quantity of bog ore is found at Meadowvale, Middleton and Inglesville, of the character called pitchy hydrate, and affords 47 per cent. of iron. In Pictou County, bog ore is scattered over many parts of the county, especially on the west branch and headquarters of the St. John, near French

River, and north of New Glasgow. In Cape Breton it is found near Sidney, at Fox Brook, Boisdale, Indian Brook, and near Schooner Pond. At Antigonish, Shelburne River, Port LaTour, and in Lunenburg County, its existence is known, but the extent is doubtful. Clay ironstone ore exists throughout the Pictou coal field forming irregular beds from 5 to 40 inches thick. Little attention has as yet been paid to them, but analyses made show a percentage of metallic iron ranging from 25 to 35, and it is considered they will prove an important addition to the other ores. At French River the beds of clay ironstone are from 6 inches to 4 feet thick. In Cape Breton beds are found at New Glasgow, Mabou, Sydney and Schooner Pond.

British Columbia.—According to Dr. G. M. Dawson, deposits of magnetic iron occur near the west end of Cherry Bluff, on Kamloops Lake, in irregular veins, up to a thickness of 3 feet or more. An analysis from this locality gives a percentage of 66 of metallic iron. At the conflux of the Nicola and Coldwater Rivers, Iron Mountain, so called from rich veins of specular ore traversing it, forms a prominent object. Iron is also reported near Nicoamen, where a vein 8 feet wide is said to have been found. On Texada Island, near Gillies Bay, is a rich bed of magnetic ore varying from one to ten feet in thickness. The ore exists all over the island, and, as deep water is found close to shore, the ores are well situated for mining and shipment. Iron is also reported at the head of Knight's Inlet; at Menzie's Bay, near Seymour's Narrows, Vancouver Island; and the west side of Fitz Hugh Sound, and on a bay south-east of Cape Commerell, on the north west end of Vancouver Island. Clay ironstones are frequent in the coal rocks of Vancouver and Queen Charlotte Islands, the nodules varying in weight from one pound to many tons. At Baynes Sound mines sufficient is obtainable to regularly supply a blast furnace. A fine granular magnetite is found on an island near the Walker Group, in Schooner Passage, Queen Charlotte Sound. It yielded on assay 71 per cent. of iron, showing the ore to be exceptionally rich.

North-West Territories.—The iron ore of the greater portion of the inland parts of this Territory is met with in nodules. These are observable more or less all through that part lying west of Rapid City, in its vicinity. Prof. Selwyn mentions nodular clay iron ore as occurring in layers near Edmonton, and large ironstone nodules. These, assayed by Mr. Hoffman, gave an average of 34 per cent. of metallic iron. He says: "They seem to be rich and valuable ore, and are all carbonates, with an external coating of hematite." Mr. Harrington, in a report on the iron ores of Canada, says the ironstone

of the tertiary age, in the vicinity of the 49th parallel, run in nodular sheets through the clays and argillaceous sands, are hard and compact in structure, and ring beneath the hammer. Considerable quantities might be gathered from the surface in some localities, and further search might bring to light enough to render it profitable to work over the entire bank. Should these ores ever come to be worked, limestone for a flux could be obtained in considerable quantities from the boulders which strew the plains.

On the east coast of Hudson Bay spathic iron ore abounds along the shore, and on Long Island highly ferruginous beds were found by Dr. Bell, which, he says, may prove valuable. Magnetic ironsand is washed out of the drift in considerable quantities along the coast, especially at Great and Little Whale Rivers, near Little Cape Jones and Langland's River. Red hematite also occurs in the vicinity of Richmond Gulf. Magnetic iron occurs on Knee Lake, between Lake Winnipeg and Hudson Bay, and its attraction was so great as to render quite useless the compass of Dr. Bell's survey party. The same fact occurred at the narrows of Lake Winnipeg, traceable to the same cause, and was noticed by Sir Henry Lefroy in 1843. Magnetic iron exists also on both the Churchill and Nelson Rivers.

LEAD.

The working of lead mines has not been carried on hitherto to any extent in any part of the Dominion.

Ontario.—The Counties of Frontenac and Hastings, especially that part of it comprising the Townships of Tudor and Lake, is said in the Geological Survey Report of 1866 to be fully entitled to the name of a lead bearing region. In Lake Township, one lode contains a vein of galena ten inches thick; in Tudor, twelve lodes have been tested, showing galena from half an inch to five inches thick. In Burgess, Bedford, Storrington and Loughborough veins carrying baryta and lead ore are abundant. The Frontenac Lead Mining Company are preparing for extensive operations in the country back of Kingston and near Sharbots Lake. The new railways about to traverse that district will do much to facilitate the mining of that part of Ontario. It has also been traced in Marmora, and at Limerick it is being worked; at Loughborough a mine was worked some time and abandoned, and it is reported as found on both sides of the Hastings Road. Several veins

containing galena occur in the Township of Bedford, and similar veins in Lansdowne. In Ramsay a mine was opened and considerable lead taken out. A well defined lode exists at Fitzroy, in the Ottawa District. At Silver Lake, Thunder Bay, is a large brecciated vein of quartz and barytes, holding galena, a 50 lb. specimen of which was exhibited at the Philadelphia Exhibition. Island No. 2, in Silver Lake, is traversed by a similar vein, from which an assay gave 57 per cent. of lead and 2 oz. 6 dwts. of silver per ton. At Enterprise Mine, Lake Superior, are some rich workings, four feet of solid ore existing at the surface. At St. Clair, Black Bay, Lake Superior, is a vein 12 to 20 feet wide, carrying promising quantities of galena. At Point aux Mines, Lake Superior, is also a vein with zinc blende. At Pigeon River, in the Nepigon District, at Neebling and Black Bay, veins occur, yielding in the latter case 47 per cent. of lead. Near Fort William, on Poplar Lodge River and Gull River, rich veins occur, and an assay from the first of these localities yielded 38 per cent. of lead, 1 oz. silver, and $\frac{1}{2}$ oz. of gold to the ton of lead.

Quebec.—Lead has been traced on the North Nation, Gatineau and Black Rivers. It is traceable in the Grenville band of the Laurentians, especially in the Township of Buckingham, where the limestone producing it is intersected by veins of opaque white sulphate of barytes. It has also been found in the Township of Hull. Considerable crushing was carried on in Buckingham some years ago. In the Townships of Upton, Acton and Ascot, it is met with, where, though not found in workable quantities, its presence is not to be overlooked. At Cooke's Corner, St. Armand, lead is found in a vein of white quartz, and at Vaudreuil. In Potton it also occurs in quartz veins in the black state. At Cape Gaspé and at Indian Cove galena is found, and attempts to mine for it are said to have been made at the former place prior to the conquest of the country; the ore here yields an assay of 60 per cent. Small quantities have been found at Perce and at Ance Cousin, on the Gaspé Promontory.

Nova Scotia.—Galena is found scattered widely in rocks of every age. It is found in the auriferous lodes of the Atlantic coast, where it sometimes holds silver up to 6 or 8 oz. to the ton of ore. At Springville and West River, Pictou County, and Cumberland, it occurs as disseminated crystals, but not in sufficient quantitity to be valuable for working. At Gay River, Halifax County, it is found scattered in crystals, aggregated about centres and occasionally in strings in the limestone. The discovery was first made by a farmer

burning lime. Average specimens only afford 3 per cent. of galena, but silver is present in it, varying from 3 to 12 oz. to the ton of lead. At Pembroke, in Colchester County, it is somewhat more concentrated. In Guysborough County, at Caledonia, a vein of galena varying in thickness from 1 to 6 inches has been tested, and some 16 tons of ore shipped. The ore is excellent, and yields by assay 86 per cent. lead and from 15 to 17 oz. of silver per ton. Indications of lead exist near Sydney and Arichat, and at Fort Hood. On the Salmon River Road, at Baddeck, and the head waters of Gold and La Have Rivers, galena has been discovered. Between the upper settlement of North River and the road to St. Anne's, traces of it exist, and one vein varying from 3 to 12 inches in thickness occurs, a sample from which yielded in Berlin 155 lbs. pig lead and 2·95 of silver to the ton of ore. This district is represented by practical miners as promising good results.

New Brunswick.—On the west side of Musquash Harbour veins of 8 inches to 1 foot of white quartz yield galena, the assay of which is a little over $14 to the ton. Another vein exists on Hammond River, at Wanamakes. No lead mining, however, is carried on in this Province.

British Columbia.—Prof. Dawson reports a large vein of galena on Scotch Creek, 12 miles from Shuswap Lake, also on the Servers Chilcotin, and that it occurs in connection with gold and silver in veins in Cariboo, Omineca, Cassiar, etc., with silver at Cherry Creek, and in small quantities in many other localities in the Province. Pellets of galena have been found in the sluice boxes higher up the stream at Cherry Creek than the known silver bearing lodes exist, which seem to point to veins of galena existing there. A mass of silver ore, weighing 20 lbs., was exhibited at the Paris Exhibition, which contained galena in composition with it. From Vernon's silver lode, on Cherry Creek, assays show galena. Lead mining, however, is not carried on in British Columbia, the prevalence of richer metals probably having prevented any outlay or prospecting for it.

North-West Territory.—On the eastern shores of Hudson Bay galena is reported to exist in sufficient quantities to be of economic value. At Little Whale River the Hudson Bay Company, in the year 1858-59, obtained nine tons of this ore in that locality. A specimen from that vein assayed in Montreal in 1875, contained 5.104 oz. of silver to the ton of ore. Another specimen, from

Richmond Gulf, in the same locality, assayed 12·03 oz. silver to every 2,000 lbs. of ore.

COPPER.

Copper constitutes one of the most important of the mineral treasures of the Dominion, and is destined to occupy a very important rank amongst its resources. Its ores are distributed over vast tracts of country in Ontario, in the Eastern Townships of Quebec, in Nova Scotia, British Columbia, and traces of it are met with in New Brunswick.

Ontario.—The richest copper producing section of this Province is that embraced by the northern shores of Lakes Superior and Huron. The north shore of the former, especially, is very rich in this mineral, where it frequently occurs in the form of native or metallic copper. Excavations of aboriginal mines are occasionally met with, and the stone implements they used are also found in them. Generally these are simply rounded pebbles of hard rock from the beach, around which shallow grooves have been made to hold the withes used as handles. Some of the hammers measure from 5 to 12 inches in length. An open cutting, supposed to have been made by the early French explorers, was found near Mamainse Point, the marks of the drills being still visible on it, and old shafts are here and there met with, the history of which is completely lost. On the south shore of Bachewanung Bay is a location of the Upper Canada Mining Company, where the perpendicular cliff facing the bay is stained with blue and green carbonates of copper. At Mamainse Point the Montreal Mining Company have a working which affords a rich quantity of gray sulphate of copper, and prisms are met with nearly filled with native copper. At Pointe Aux Mines a number of veins exist; to the north of this, at Mica Bay, the Quebec Mining Company expended a large amount of money on a vein which, though rich in ore, was not lasting enough to be productive of results that warranted a continuance of their works. A number of localities on Michipicoten Bay and Island afford rich workings. Here is situated Fletcher's Mine, from which large quantities of ore have been extracted. Along the coast veins here and there appear east and west of Otter Head. The north-west shore, up to where the boundary line strikes the lake, and especially the Island of St. Ignace, Black Bay, Fluor Island, Simpson's Island, Point Porphyry, Edward's Island, Thunder Cape, Pie Island, Prince's Bay

and Spar Island are all rich in copper. In these last named localities native copper is abundant, and large masses of it are met with. Prince's Bay mine gave for a time very rich results, the copper being richly associated with a variety of other metals. Pigeon River and the district south-west of the Kaministiquia River have afforded good yields in their time. Many of the workings in the whole of this district have been abandoned, a fact attributable to want of capital or injudicious outlay. It is asserted that the Superior district contains the most extensive copper deposits in the world, capital being all that is required to develop them.

Along the shores of Lake Huron copper is abundant, in fact scarcely any large area throughout this region is destitute of copper bearing veins. The Bruce Mines, belonging to the Montreal Mining Company, discovered in 1846, and which have given the name to a village that sprung up around them, rank the foremost. The ore is chiefly copper pyrites. Smelting works were at one time erected on the spot, but, the process being found too costly, they were abandoned, and the ore is now shipped to Baltimore and to England, after being crushed, puddled in troughs and washed in pure water, when it yields about 20 per cent. of pure copper. Close by the Bruce is the Wellington Mine, owned by the Montreal Company, but leased to another. The ore veins here sometimes attain a width of ten feet, and extend to the next location, known as Huron Copper Bay Mine. The Wallace Mine, at the mouth of Whitefish River, has a vein of from six to sixteen feet in width; Spanish River and its vicinity is rich in thick and numerous veins; Echo Lake, near Lake George, the land on the east branch of Cariboo River, which falls into Echo Lake, and Limestone Point, all give abundant show of copper. At Root River a mine has been opened called the Emerald Location. In fact on every portion of the Huron shore, and for some distance from it, there are indications rich enough to lead to the belief that ere long this section will be one of the best mining sections of the country.

Traces of copper in the form of pyrites have been found in the County of Hastings, in Hungerford Township, and Anglesea, west of the Addington Road, and occasionally scattered elsewhere, but of no economic value as far as known at present.

Quebec.—In Eastern Canada, the native copper, which is so abundant in the Superior district, is rare. It is met with in a few cases, but only to a slight degree. The copper deposits of this part of Canada were stated by Sir W. Logan to be very similar in their structure and mode of occurrence to those of Norway and Sweden. In some of the localities in Quebec the metal is met with as a sul-

phuret, but the veins are seldom continuous for any great distances. At the first commencement of copper working in that section a great rush was made for mining rights ; companies were formed, the majority of which sank a great deal more money than they could ever make, having consequently to yield to the pressure of the times before any returns on outlay could be made. But, despite all this, sufficient has been developed to prove that in several districts in that part of the country copper mining may be carried on successfully. The mines of this Province generally can be distinguished as being found in different mineral districts, differing from each other by marked peculiarities of the ores found as well as the nature of the deposits, but would require a longer description than falls within the limits of a handbook. The Geological Survey Report of 1866 enumerated the extraordinary number of 557 locations in the Eastern Townships where copper exists and has been traced. The Acton Mine, in Bagot County ; the Harvey Hill Mine, at Leeds, in Megantic County ; the Prince of Wales and Bissonette's Mines, in Upton ; the St. Francis Mine, near Richmond ; the Lower Canada and Albert Mines, near Sherbrooke ; and a mine at Garthby, were at one time all being worked, and smelting works at Lennoxville were in operation. The Coldspring Mine and Balrath Mine, in Melbourne, the Brompton Gore Mine, the Ascot and Belvidere Mines, Victoria, Reid Hill, Warrington, Griffiths, and Ham, all gave good evidences of copper, but respectively were abandoned. Copper is traced through the Townships of Potton, Bolton, Stukeley, Orford, Brampton, Melbourne, Cleveland, Shipton and Ham ; and in numerous other localities, such as Wickham, Durham, St. Flavien (Black River), Sutton and Halifax, explorations made by various parties have shown the existence of considerable quantities of copper ore in the form of sulphuret rich in copper. In the Ascot district these mines have been worked for some time, viz : the Hartford (Canadian Copper and Sulphur Co.) ; Crown Mine (Orford Nickel and Copper Co.) ; and the Albert Mine (Messrs. G. H. Nichols & Co.) ; besides these, two mines are now being opened under favourable auspices, the Sheffield Mine and the Hepburn Mine.

The Eastern Townships ores demand a peculiar metallurgical treatment, and to separate the copper from the gangue they require an addition of power and more sulphurous ores in the smelting works, and in the *Geology of Canada* the statement is made that the quantity of fuel required by the present mode of treating the ores is such that the richer ores must be carried to the vicinity of coal ; and adds "it may be anticipated that those from Eastern Canada will eventually find their way to the coal mines of the Lower Provinces."

New Brunswick.—Copper ores are found in many localities in New Brunswick, more especially in the southern part of the Province, but their attempted development has in no case met with success. The ore is found in quartz beds which traverse schists and slates, the copper being usually in veins, but sometimes disseminated in lumps or grains. The principal localities where it is met in abundance are Salmon River, Albert County, one specimen from which, according to the Provincial Report, prepared for the Philadelphia Exhibition, is said to have yielded to analysis 62 per cent. copper; Adams Island, Charlotte County, and Grand Manan; in each of these it exists as a gray or yellow sulphuret. In Westmoreland County, Dorchester, a deposit of green carbonate has been discovered, but the Government Survey Report of 1877-78 says that as no regular vein exists no satisfactory results are likely to be attained.

Nova Scotia.—The reports of some of the members of the early French expeditions to Canada and Acadia on the supposed mineral wealth of Nova Scotia and Cape Breton was one of the reasons why France struggled so strongly to retain her supremacy in British America. In this connection Lescharbot, writing in 1609, speaks of the native copper of the Bay of Fundy as being "very pure in the stone," the stone alluded to being the trap and triassic sandstone of that district, in which copper is found in small grains and lumps. In his remarks he further went on to say "many goldsmiths have seen it in France which do say that under the copper mine there might be a gold mine, which is very probable." Attempts were made some years ago to mine the ore near Margaretsville, Annapolis County, but it was too insufficiently distributed to permit systematic mining. In Antigonish County, where large sums of money have been spent; Pictou, Cumberland, at Malagash, where grey and green ores exist, and in other counties, outcrops of vitreous sulphuret and green carbonate occur. These are supposed to have originally been accumulations of vegetable matter in the swamps and estuaries of early ages, where as the strata became solidified the ores of copper were deposited from aqueous solutions. Dr. Dawson gives a sample of these ores from Cariboo and Pictou as yielding on analysis 40 per cent. of copper. At Tatamagouche, in Colchester County, the ores are attracting much attention. In King's County stray indications of copper are found, and at East Dalhousie vitreous and gray carbonates, with blue and green carbonates, have been tested.

In Lunenburg County, at Blandford Cove, copper pyrites exist, and the latter is a common mineral in the gold bearing lodes of the

Province. At Lochaber the ore is unusually good, being pyrites with a slightadmixture of carbonate; analyses from three veins there gave 19, 29 and 31 per cent. of metallic ore. On Salmon River, the Primrose property contains a small vein of rich ore, which yielded, under Dr. Haye, State Analysist, at Boston, from 37 to 39 per cent. of metallic copper.

In Cape Breton numerous localities give traces of ore, notably at the White Granite Hills, Gillis Brook, Bras D'Or, Garbarus, Eagle Head, Cheticamp and Cape North. Professor H. Y. Hind considers that the deposits of copper may be the remains of plants replaced by metallic ores, but the mineral often forms the matrix of the conglomerate.

British Columbia.—Traces and veins discoloured with copper are found in many localities in rocks of very different ages in this Province. Masses of native copper have been from time to time found, derived probably from the volcanic rocks, as they have not yet been discovered in the matrix. The gold and crystalline rocks of the Coast Range, and the supposed carboniferous rocks of Vancouver Island, yield small cupriferous veins.

At Copper Creek, on the north shore of Kamloops Lake, the Indians were formerly in the habit of procuring native copper, though probably in small quantity. It has been traced there by the Hudson Bay Company in the form of grains of native copper and as copper ore (bornite). At Copper Island, on Shuswap Lake, it is found in schists as pyrites, and pellets of native copper are met with on the Fraser and Similkameen Rivers. Near McDonald's Creek, on Nicola Lake, fragments of rich copper ore are found. The following localities are also given in the Geological Survey Reports: between Innis Inlet and Howes Sound, purple copper ore (bornite) and pyrites; Knight's Inlet, entrance to Howes Sound, copper pyrites; Sansome Narrows, the same; east entrance of Lake Henbun, scales of native copper; a shaft has been sunk 120 feet but abandoned; Dean Canal, yellow and purple copper; Head of Kitemat Inlet, yellow sulphuret of copper; Thompson's River, below Spence's Bridge, rich purple ore and native copper; Fraser River, 30 miles above Fort George, native copper; Fraser River, 10 miles below Lilooet, native copper; Bate's House, Waggon Road, native copper; Quesnel River, near Forks, native copper; Moresby Island, Queen Charlotte Islands, and Port Frederick, copper ore; and Homathco River, copper pyrites and purple ore.

North-West Territory.—On Long Island copper pyrites, and at Richmond Gulf, in the Hudson's Bay and Rupert's Land District, pure copper pyrites, are reported to exist.

NICKEL.

Nickel and cobalt are so generally associated in nature that it becomes necessary to mention these two metals together.

Ontario. — The Wallace Mine, on Lake Huron, shows a fine grained steel grey mixture, containing, amongst other metals. 13 per cent. of nickel and small quantities of cobalt. On Michipicoten Island two ores of nickel have been found and assayed, one being a bright massive ore, associated with quartz, having a bright metallic lustre, and in colour varying from tin white to bronze yellow. This ore yielded, on assay, from 17 to 36 per cent. nickel, and traces of cobalt. The other ore is a greenish earthy silicate of nickel, yielding about 24 per cent., and traces of cobalt. At Elizabethtown, near Brockville, cobaltiferous pyrites are found, containing nickel, and the same at Escott, in that vicinity.

Quebec.—In the Seigniory of Daillebout, on River Assumption, iron pyrites, with oxide of nickel and cobalt, are found. In Orford Township sulphuret of nickel is disseminated in grains and in crystals of garnet and calcareous spar. The ore yielded 60 per cent. but the spar only 1 per cent. of nickel. In Sutton it is found as nickeliferous pyrites; in Bolton as a hydrocarbonate, incrusting fissures in the rocks with a green stain. In Bolton and Ham it is associated with chromic iron ore, and in Granby it is met with in the earthy limestone. Pigeon Lake, on Montreal River (Ottawa Valley), shows nickel in its serpentine rocks.

Nova Scotia.—Traces of nickel and cobalt are abundant in this Province, but in small quantities. At Montagu and at Cochrane's Hill, Guysborough County, cobalt occurs in mispickel, and associated with copper at Cariboo, Pictou County. Both metals have been detected at Newport, and in pyrites from Nictaux and Geyser's Hill. Nickel is also found in small quantities in the pyrites of the Londonderry iron mines. In the pyrites of the gold districts it is detected, and in samples from Musquodoboit and St. Mary's it exists up to 3 per cent.

British Columbia.—Nickeliferous sand has been obtained in gold washing on the Fraser River.

ZINC.

Ontario.—The only form in which this metal has been ascertained to exist in Canada is the sulphuret or zinc blende. In Ontario it occurs in some of the veins on Lake Superior, at Mamainse, and at Prince's Mine, where it is abundantly mixed with copper glance and native silver. At Blande Lake a shaft has been sunk 25 feet, from which specimens were exhibited at the Philadelphia Exhibition. A vein 3 or 4 inches wide, containing zinc, exists in the Township of David, and Thunder Bay shows blend in promising quantities. It is also occasionally met with in small masses of a honey yellow colour in the limestones of the Trenton group at Kingston, and in the dolomites of the Niagara formation. At Niagara Falls it sometimes appears to replace fossils, and at other times it is found imbedded in nodules of gypsum in wax yellow cleavable masses.

Quebec.—Zinc has been found in small quantities in veins of calcite in the County of Berthier and at St. Irenée. It exists also at St. Amand, in Leeds, and at St. Francis, Beauce. It occurs at the Ramsay lead mine. It is to be found in the Trenton limestone at Montreal and Montmorency Falls.

Nova Scotia.—In this Province zinc has only been found as an accessory mineral in auriferous quartz lodes.

New Brunswick.—Mr. Matthew reports (Geol. Survey, 1876-77) that in the Kingston rocks of King's County zinc exists among other metals.

North-West Territory.—Zinc blende is found with calcspar in small veins cutting the dolomites of the south side of the Little Whale River, and in crystals with the galena in the lead bearing band in other localities in that district. Although it was not noticed in economic quantities by Prof. Bell in 1877, its existence he considers worth noting, as it may be found to occur in larger abundance on that part of the Hudson Bay coast (east).

In British Columbia and Vancouver Island there is no mention in any official records of zinc existing which has been as yet traced.

SILVER.

Ontario.—Native silver is found at many of the copper locations on Lake Superior, sometimes mixed with copper glance and sometimes with native copper. In fact the northern shore of Lake Superior may be said to be rich in silver in certain localities. Silver Islet, originally a mere rock, whose greatest diameter was 75 feet, and greatest height above Lake Superior about 8 feet, situated some half a mile from the mainland of the north shore, and a few miles east of Thunder Cape, has obtained the most prominent name in all the silver bearing district. The vein was first discovered in 1868, and was worked by the Montreal Mining Company for two years. They then disposed of it and mineral lands on the lake, in all 107,000 acres, to an American firm. Since then the mine has been steadily worked, and it extends to a depth of 550 feet below the surface of the lake, and yields a very remunerative return. It is estimated that over $3,000,000 worth of silver have been taken from this mine. Other silver workings exist at Jarvis Island, Pine Bay, McKellar's Island, Pie Island, Singleton Mine, near Prince Arthur's Landing, Duncan and Shuniah Mine, Thunder Bay Mine, etc. In the Shebandowan district silver is found associated with other ores in grains and thin leaves in a quartz vein well defined. At Heron Cove, near the Pie, a quartz vein yielded on assay 7 oz. to the ton of rock. Argentiferous galena has been found on Lake Temiscamingue yielding from 11 to 18 oz. of silver to the ton. Argentiferous galena exists abundantly also in the Lake Superior district. In Madoc, Galway, Denbigh and other lead producing districts of the Counties of Hastings, Frontenac, and that section of Ontario it has also been discovered, though of no extensive value.

Quebec.—In the Eastern Townships the copper ores met with there frequently contain small portions of silver, such as those of Acton and Ascot. The lead ores of that district all contain more or less silver, and there is a vein at the rapids of the Chaudiere, on the St. Francis, Beauce, which assayed 37 oz. of silver to the ton. The galena of Markham Hill gave an assay of 65 oz. of silver to the ton of lead. Generally, however, the quantity contained is small, Bedford yielding 2 oz., Lansdowne 1½ oz., Ramsay 2½ oz., Acton 2 oz., and Upton from 2 to 3 oz. of silver to the ton, whilst specimens from Bay St. Paul, Brome, Chateauguay, the North Nation and Buckingham yield only traces of silver. The native gold of the Eastern Townships is always alloyed with a portion of silver. Specimens of silver have been brought

from the Upper Ottawa and Gatineau districts, but very little is known of the veins existing there.

Nova Scotia.—Native silver and its carbonate, in veins of soft spar, on the Mackenzie River, of Inverness County, Cape Breton, was reported by Mr. Campbell and Mr. Barnes nearly twenty years ago, but no further discoveries have been made since their reports. The district lying north of Bras d'Or Lake has, however, been little explored by mining engineers, and from the reported presence of other minerals in that locality it would afford a promising field to the prospector. The auriferous lodes of the Atlantic coast hold silver bearing galena yielding 6 or 8 oz. of silver to the ton of ore. The lead ores of the limestones of the silver carboniferous system show from assays made silver associated therewith varying from 3 to 12 oz. to the ton of lead. From the head waters of the Gold and LaHave Rivers discoveries of galena were made in 1879, carrying in some cases 100 oz. of silver to the ton. An analysis of Dr. Hayes, made from a quartz vein at Boulaceet Harbour, showed 39 oz. 10 dwt. and 12 grs. of silver to the ton. The lower carboniferous limestones cover a large extent of ground in Nova Scotia, and may reasonably be expected to afford indications of the presence of silver lead ores.

New Brunswick.—Of the localities producing galena few have been examined for silver. One on Hammond River, at Wanamakes, in which a yield of fair proportion was found, is mentioned in the Geological Survey, 1878-79. Another was opened in 1878 on the west side of Musquash Harbour, where veins of white quartz carrying galena yielded on an assay by Dr. Harrington 14 oz. to the ton. He says: "The veins are stated to occur in rocks of the Laurentian age, but the galena contains more silver than any other from the Laurentian which I have examined." The extreme hardness of the rock and smallness of the vein are against the profitable working of this location.

North-West Territory.—On the east coast of Hudson Bay Mr. Bell reports the galena of Whale River as assaying 5 oz. of silver, and that from the inlet of Richmond Gulf 12 oz., to the ton of ore. It has also been traced in pyrites veins on Dog Island and near Teska Harbour.

British Columbia.—An argentiferous locality, six miles from Hope, on the Fraser River, is thus described in the Report of the Minister of Mines of British Columbia: "The lead called the

Eureka Mine crops out about 5,000 feet above the river level, is well defined, 4 to 7 feet in thickness, and has been traced 3,000 feet. A tunnel has been driven into this 190 feet. The ore is described as argentiferous grey copper, yielding under assay from $20 to $1,050 worth of silver to the ton. Another lead 3,000 feet distant is called the Van Bremer Mine. The ore is described as chloride of silver, yielding to assay from $25 to $2,403 worth of silver to the ton of rock. It is readily traceable for half a mile." In the rough state, the ore as extracted from the mine and carried to the river by the present rude appliances has been sold at San Francisco at $420 per ton. Cherry Creek, a tributary of the Shushwap River, between Okanagan and Arrow Lakes, is noted as a locality from which specimens of remarkably rich silver ore have been brought, and which Mr. Dawson, of the Geological Survey, states "may eventually be an important mining region." Pellets of argentiferous galena found in the sluice boxes on Cherry Creek assay at the rate of 220 oz. to the ton. On the north fork of this stream a sample of quartz yielded $300 worth of silver to the ton, but the average is probably about 8 oz. Small pellets of native silver have been found in gold placers on the Similkameen River and Mission Creek. Native silver or silver amalgam has been found in the Omineca District, and argentiferous galena ores occur in many parts of the Province. A specimen of the latter, obtained on a stream running into Mission Creek, 30 miles from Dunkeld, yielded on assay 8·971 oz. of silver to the ton of quartz in which it was found; and if hand dressing were resorted to a very satisfactory yield might be anticipated.

GOLD.

Ontario.—At Prince's Mine, Lake Superior, traces of gold have been found associated with native silver, but in very small quantities, and at about a mile east of Huron Cove, near the Pie. It has also been traced in the Lead Hills location, near Black Bay, careful assays of which, made by Prof. Chapman, gave amounts of gold yielding from 14 to 19 dwts. per ton. The *Geology of Canada*, comparing the copper bearing rocks of that region with those in Eastern Canada, says "it is not improbable that gold may one day be added to the list of the mineral riches of Lake Superior." In the Shebandowan district gold is found in grains and laminæ 15 to 20 miles south-west of the Lake. Traces of gold have been found in quartz on Long Island, in the Lake of the Woods, and at Rat Portage.

In the County of Hastings, especially in the Townships of Madoc, Elzevir, Hungerford and Marmora, gold exists in paying quantities, the richest deposits being in crevices of the rocks, in a brown ferruginous earth. It is found also in quartz and sulphurets and associated with antimonial grey copper ore. The gold fields of Madoc, when first discovered, in 1866, attracted considerable notice, but it soon was ascertained that the only way in which the mineral could be made to pay in that district was by mining and crushing. The localities in Elzevir, Madoc, Marmora, Lake and Tudor, in which openings were made by prospectors, are reported by a member of the Geological Survey staff to be too numerous to mention. Assays made by Dr. Sterry Hunt gave as follows: Empire Mine, $206 to 2,000 lbs. dressed ore; Richardson Mine, ferruginous earth taken from crevices yielded from a trace of gold to $380 per ton; shaft at Berry's Mill, 9 dwt. to the 2,000 lbs., and other shafts small traces only. From assays made by other experts, the Kotanney Mine showed a result of $12.50, and the Madoc Company Mine, $12.66 to the ton. The Royal Canadian, Excelsior, Brantford, and others, all afforded about the same results. Gold from this locality was exhibited at the late Philadelphia Exhibition, and the official report of Ontario on that subject states: "Twenty assays made in the Geological Survey laboratory of samples from the Marmora mines have given an average of 1·6367 oz. of gold, equal to $33·81 to the ton of 2,000 lbs. Twelve of the samples were from the Gatling mines, and gave an average of 1·1907 oz. of gold, equal to $39.47 to the ton." The region embracing gold in this district is supposed to extend from Madoc to the northern shores of Lake Huron, and time only can unfold its hidden wealth. There are no alluvial deposits, and consequently no washings, in the creeks of this section of Ontario.

Quebec.—The operations in gold mining in this Province have hitherto been carried on principally in the Chaudière district, in alluvial diggings in the River Gilbert, and in the Seigniory of De Lery. Sir William Logan, speaking of this, remarked that, "*while the quantity of gold in the Chaudière Valley is such as would be remunerative to skilled labour, and should encourage the outlay of capital, agriculturists, artizans and others engaged in the ordinary occupations of the country would only lose their labour by turning gold hunters.*"

Mr. Michel, of the Geological Survey, reported as follows:—

"The rule which appears to govern the distribution of alluvial gold in all other regions where it has been wrought holds good in Lower Canada. Here, as elsewhere, the layers of alluvion, which

contain the precious metal, are not continuous, but occur in sheets or belts of greater or less extent and of variable thickness. The proportion of gold in these sheets or belts of alluvion is also far from uniform and regular, the richer portions being met with in patches more or less remote and isolated from each other.

"When we consider that the existence of alluvial gold has been demonstrated over a great extent of territory in Lower Canada, and at the same time take into account the deposits, some of considerable richness, which have been met with in the rivers Chaudière, Guillaume or Des Plantes, Touffe des Pins or Gilbert, Famine and Du Loup, we may reasonably suppose, especially when we consider how limited have been the researches hitherto made, that there may exist in the alluvial deposits of the Chaudière basin *other localities as rich in gold as any yet discovered*, and perhaps over extended areas whose regular working may be made profitable, and a vast field for exploration in Quebec is now open. Its actual presence has been traced from as far west in the Province as Lake Champlain to as far east as the head waters of the River du Loup (*en bas*), and it is said to be highly probable, from the mineralogical resemblance of the region beyond, that it may be yet found to extend to the extremity of Gaspé. Roughly speaking, it has been satisfactorily demonstrated that the drift clays and gravels, as well as the quartz veins in the rock formation, of most of the country on the south side of the St. Lawrence between the extreme eastern and western points just mentioned, the Notre Dame range of hills to the north, and the Provincial or boundary line to the south, are more or less auriferous—the whole constituting an area of about 15,000 square miles, of which some 1,000, comprising the section drained by the Chaudière and St. Francis Rivers, are presumably the richest in deposits of the precious metal."

An official report of the Commissioner of Gold Mines in Quebec says :—

"Gold is to be found everywhere from St. Francis to the lines, a distance of 43½ miles; and if thoroughly worked for, as on the Gilbert River, would be found in as great abundance anywhere. The native gold is coarse; one does not meet with that fine pulverized gold as found in California; if so, it is in very small quantities.

"On the River Famine the gold is also coarse; it is to be found in slate at the foot of the Falls. Experienced men and geologists entertain a very high opinion of this river, from the formation of its rocks and the general lay of the land.

"On the Du Loup, in its entire length, gold is to be found; also a great quantity of black sand, which has yielded as much as 22 dwts. per ton of 2,000 lbs.

"The mouth of the Du Loup has also brought out innumerable small veins, running parallel to each other, in which gold has been found. On the Millstream and at the Grand Coudee, both tributaries of the River du Loup, quartz has been assayed, and found to contain gold. At the Devil's Rapids, a little above St. Francis, numerous lodes, and some of them very large, are supposed also to contain gold; they here exist on both sides of the Chaudiere. About the Metgermette and the Oliva fine quartz is also to be met with. Not very distant from those two rivers, quartz is found on the Du Loup, which having been assayed gave eight dwts. to the ton; this was also taken from the surface. Between the Portage and Kempt streams, tributaries of the Du Loup, two large veins are observed; they also contain gold. A short distance from the Monument River, a beautiful vein of quartz is to be seen from which gold has been extracted by merely breaking the surface of the quartz with a hammer."

A writer in *La Minerve* recently estimated the yield in Quebec, from the date of the discovery of the precious metal on the Chaudiére, at an approximate total of 117,000 ounces, of which about 70,000 were taken from the Chaudiére and 40,000 from the Eastern Townships.

There is every reason to conclude that, with proper facilities, the working of the gold deposits of Quebec will show an increased activity, on a wider and more permanent basis, with remunerative returns to those who invest capital.

Alluvial gold workings are being carried on near Sherbrooke, by the Hon. J. H. Pope, from which a very fair return is yielded, and the gold is of a very fine colour and quality.

New Brunswick.—Gold has been reported as occurring at several points in the metamorphic rocks of Albert County, but no reliable data are given. Mr. Ells, of the Geological Survey, had specimens examined, which in nearly every case proved to be pyrites. Many of the quartz veins, however, show traces of galena, and resemble those of the auriferous areas of Nova Scotia, and the occurrence of visible gold in the quartz pebbles of the carboniferous conglomerates of the coast lead to the inference that diligent search may yet be rewarded, although washings made at various points in that district have not as yet disclosed any traces of gold. Small quantities of gold have been found in the Tobique River, a northern tributary of the St. John. It is highly probable that the quartz veins of the Province of Quebec extend across the central part of New Brunswick in the direction of the Bay of Fundy.

Nova Scotia.—The gold mines of Nova Scotia are one of the chief sources of wealth of that Province. The earliest discovery of gold there made known to the public was in 1860, near Tangier Harbour. In 1861 the Government formally took possession of the district, and commenced laying off mining lots for lease. A commissioner was appointed and reports began to be issued in 1862. The law of "Mines and Minerals" provides that quartz (gold) mines shall be laid off in areas of 150 feet along a quartz lode by 250 feet across, in rectangular and quadrilateral shape. Leases are for 21 years, under certain terms. Prospecting licenses cover an area not exceeding 100 acres, at 50 cents an acre for the first ten, and 25 cents an acre for the remainder. Quartz mills must be licensed, and books kept open for public inspection, by which reliable information can be obtained of the gold workings. This official supervision removes one of the greatest objections to the investment of capital in gold mining, and affords a solid basis on which to form a calculation as to results.

The metamorphic district of Nova Scotia, the most rugged and uninviting portion of its surface, has become, by the discovery of gold, one of its richest sections. The Atlantic coast, from Cape Sable to Cape Canso, is occupied by a series of measures which present a rough undulatory surface, broken by arms of the sea running far into the land, and which extend some 280 miles in length and about 30 miles inland. These measures contain bands of gold bearing rocks variously estimated to cover an area of 6,000 or 7,000 square miles, but probably may be more correctly stated, as Professor Hind asserts, exceeding 4,000 square miles. These bands contain numerous veins or "leads," varying in thickness from a fraction of an inch to several feet, and it is only in certain localities, as discovered so far, that the auriferous deposits and decomposed rock afford alluvial diggings, but Mr. Gilpin, the Government Inspector of Mines, says in his latest report: "Numerous widespread surfaces exist where alluvial gold mining cannot fail to be pursued with great profit, if sufficient capital is embarked in the enterprise. Tangier, Oldham, Sherbrooke, Waverley and Renfrew present all the conditions for alluvial diggings." At Waverley drift deposits exist 50 feet deep, and a similar state of things exists at Tangier.

Quartz mining, however, is the more remunerative method of working the gold fields of this Province, and, situated as they are with excellent roads, growing towns, settlements, and navigable waters near them, their importance cannot be too highly estimated.

The principal mining districts for gold in this Province are Cariboo, Moose River, Fifteen Mile Stream, Gay's River, Laurencetown, Montague, Waverley, Oldham, Renfrew, Sherbrooke, Isaacs,

Henburn or Stormont, Wine Harbour, Tangier, and Mount Uniacke, and in numerous other localities gold is reported as existing.

Cariboo is some 6 miles south of the Musquodoboit River, at Hamilton's Corners, and 36 miles from Shubenacadie Station. Several lodes here have paid well, but work on them has only been of an intermittent character. One of these, the cross lode, at one time gave quartz carrying 20 oz.

Moose River.—This district lies 7 miles west of Cariboo, and is reached by a road from Middle Musquodobit. It has only recently received attention; the surface is reported to carry gold. Several rich boulders have been found there.

Fifteen Mile Stream.—This district lies on a tributary of the East River of Sheet Harbour. It is, however, isolated, not easy of access, and these facts have retarded the opening of this district. Explorations show the presence of a large number of promising lodes.

Gay's River.—In this district gold occurs in grains and scales and small lodes in slate. The drift also yields gold. Mining here is done by levels.

Laurencetown.—This district lies 12 miles east of Halifax Harbour. In the early days of mining a considerable quantity of gold was taken from rich boulders and washings. The chief vein on the Werner property was 8 inches thick. The Townsend property embraces several gold bearing veins; the Waddilow property includes thirteen. Operations have of late been almost suspended in this district, after large sums were expended in machinery, mills, and preparatory work. A large number of promising lodes are known here, and probably another successful start will be again made.

Montague.—This district lies about 6 miles east of Dartmouth, near Lake Loon, and has turned out a good average. The best lodes in it are the Belt, Werner, St. Patrick and Cross veins. The Belt has been worked by several parties, one of whom, in five years, extracted 10,000 ounces, with a handsome profit. The lode varies from 4 to 20 inches. Another lode, known as the Rose, from the colour of the quartz, varies from 4 to 18 inches, and out of 292 tons of quartz crushed 1,086 ounces of gold were extracted. Some American capitalists are now working it, and have erected a steam mill.

Waverley.—This district lies 3 miles east of Windsor Junction Station, on the Intercolonial Railway. The returns from it were at one time 14,000 ounces in one year, but they have much diminished of late. The main leads seemed to become impoverished the deeper they are worked. Operations are now chiefly carried on by indi-

viduals, who have taken out blocks left by previous workers, at a fair yield.

Oldham.—This district lies 3 miles east of Enfield Station. The chief lodes are the Barrel, Ohio, Frankfort, Ritchie, Hall, Britannia, etc. On one lode 1,280 ounces were taken out in five months. The Inspector of Mines says, in his last report: "The district promises to be one of unusual richness."

Renfrew lies 7 miles west of Enfield Station, near the north end of Grand Lake. The returns here at first were very good, then decreased, and are since improving. The Ophir Company here for several years realized handsome profits, taking in 5 years 17,532 ounces from 21,012 tons of quartz. All the mining here, so far, has been on the south side of the anticlinal; on the north side, although rich boulders have been found, the parent lodes remain for future workers. Professor Hind reports favourable conditions for the accumulation of alluvial gold here.

Sherbrooke.—This district lies 35 miles by stage from Antigonish, on the Halifax and Cape Breton Railway, and ranks first in the list of the Nova Scotia gold fields. The Wellington vein has been worked ever since the discovery of gold in the district, and it and other veins have been mined to a depth of from 400 to 600 feet. Care and prudence have characterized the works and good returns have been the result. In 5 years 12,215 ozs. were extracted from 8,984 tons. Other veins have yielded well, and from the continual discovery of valuable lodes encouraging results may be expected for some time to come.

Isaac's Harbour or *Stormont* lies east of Sherbrooke. For some years very good returns were given from workings here, but lately the mines have been comparatively neglected. Mr. Gilpin reports: "No district in the Province has better promise for the future. Promising lodes have been found, but have not yet been thoroughly tested." The Mulgrave lode gave 1897 ounces of gold from 621 tons of quartz.

Wine Harbour.—This district lies on the coast, 4 miles east of the mouth of St. Mary's River; 12 miles from Sherbrooke. The Provincial Company's property has frequently made good yields, the Caledonia Company having mined on it in six months $200,000 worth of gold. The Hattie lode has also yielded well.

Tangier.—This lies on the Atlantic coast, 50 miles east of Halifax. In its eastern part, at Strawberry Hill, work has been carried on for a number of years; a variety of lodes here have yielded fair returns and have only been worked to a moderate depth. Considerable alluvial gold was found at one place in this district, and a pond called Copper Lake was partially drained to get

at it, at the bottom of which, under the mud and vegetable matter, small nuggets were found to a large extent in the clay. But the drainage was not carried deep enough to allow proper investigation.

Uniacke.—This gold field is about 3 miles from Mount Uniacke Station, on the Windsor Railway. A large number of lodes have been exposed over an area of about one and a half miles broad and six miles long. These veins abound in other minerals besides gold.

The above constitute the principal gold districts of the Province; but in numerous other places small workings are carried on. Of late years the tribute system seems to have superseded the work of companies. The principle of tribute working is for ten or more practical working miners to take a mine that a company has failed to work at a profit, for a term of six months or a year, with the understanding that they pay the company a tribute or percentage of the value they extract. As a consequence, they select only the most profitable parts, work at as cheap a rate as possible, and, being without capital to properly work a mine, simply are makeshifts, and leave the property in a very unsafe condition. Water accumulates, to the detriment of neighbouring works, and, although they often get good returns, the final results are unsatisfactory. The testings of all the mines in Nova Scotia have been much neglected, and, with proper appliances, the leading authorities, such as Prof. Hind or Dr. Sterry Hunt, and others, assert that a large yield could be procured by working them over carefully. It has been asserted that 20 per cent. of the gold originally present in the lodes is allowed to pass through the mills to the nearest brook or pond. Mr. Gilpin states that Nova Scotia gold is an alloy in which silver forms the chief of the impurities.

Taking everything into consideration, the returns from these gold fields are highly satisfactory. Operations both of mining and crushing can be carried on without difficulty through the winter, and, situated as the districts are near navigable waters, and easy of access, they are of great importance and value, and, with the introduction of capital, cannot fail to be remunerative. The latest report published shows the yield for 1879 to have been 13,801 oz. from 15,936 tons of quartz crushed; 40 mines worked, and 28 crushing mills in operation.

British Columbia. — The gold bearing districts of this Province extend over several thousand miles of country, but in the discovery and development of gold mines British Columbia labours under many disadvantages, chief among which may be mentioned the comparatively short time the country has been settled, the in-

accessibility of the mining regions, and cost of labour and supplies. In addition, a large part of the country is forest clad. Professor Dawson, of the Geological Survey staff, says there is scarcely a stream of any importance in the Province in which the "colour" of gold cannot be found. The discovery of the precious metal in 1858 led to an influx of miners, and their camps are as orderly as any English country village. Gold claims are taken up anywhere on payment of five dollars (£1 sterling) per annum, and a $25 (£5 English) license secures a miner in his rights. No further tax is levied. The nature and size of gold claims in this Province are as follows :—

For "Bar diggings," a strip of land 100 feet wide at high water mark, and thence extending into the river to its lowest water level.

For "dry diggings," 100 feet square.

"Creek claims," 100 feet long, measured in the direction of the general course of the stream, and extending in width from base to base of the hill on each side.

"Bench claims," 100 feet square.

"Quartz claims," 150 feet in length, measured along the lode or vein, with power to follow the lode or vein, and its spurs, dips and angles, anywhere on or below the surface included between the two extremities of such length of 150 feet."

When a creek has "prospected" well for gold, it is usual for miners to form themselves into companies of from four to eight, or upwards, to take up their claims in proximity to one another, and to work the whole ground thus claimed for the benefit of the company. If rich "pay dirt" be struck, and the mine be in a sufficiently advanced state, companies, anxious to obtain the greatest possible quantity of gold in the shortest possible space of time, will frequently employ additional working hands and work during the whole 24 hours.

The conditions of gold mining have changed of late years in several important respects. The steady improvement of communications and the growth of farming settlements in the interior have reduced the price of necessaries at the diggings. The miners themselves have long ago given up fancy mining, and come down to economy and hard work. It would be too much to say that the shallow diggings in British Columbia are worked out, as those of California and Australia have long been, but it is true that in several important gold fields the *more easily worked places* have been exhausted.

This is a very different thing from the exhaustion of the gold fields. It is simply saying that in those particular places in British

Columbia a stage has been reached which was reached long ago in California and Australia.

The value of gold known to have been obtained during 20 years is estimated in round numbers at about *forty million dollars*, exclusive of that carried away by Chinamen and others unrecorded. The above result is arrived at from what is actually known to have been shipped by banks and express companies, as no official record is kept of the export of gold.

The *Cariboo* district has been the most permanent and productive, in which Williams and Lightning Creeks have yielded the greater part of the gold. By regular mining operations old buried river channels have been reached, and the Van Winkle Mine, on Lightning Creek, has yielded as much as $12,000, $14,000 and $15,000 occasionally, per week. The average depth of the workings is 70 feet. The machinery employed at all the works here is inadequate to the undertaking, owing principally to a want of capital and the great cost of supplies and labour.

The *Kootenay* and the *Omineca* districts labour under the disadvantage of high priced labour and excessive cost of transport, supplies from Yale to the latter costing for that 18 cents a pound. Extensive prospecting is out of the question as a private enterprise, but all who have left these districts appear favourably impressed with their prospects.

The *Cassiar* district is the latest and most northern discovery in the auriferous belt of British Columbia, and although 300 miles distant from Omineca it has attracted from that quarter many miners. Dease and McDame Creeks are the two best yielding parts of Cassiar. The mines here are worked at great disadvantage, and in almost an Arctic climate; they are reached after a sea voyage to Victoria by the River Stickene, and supplies of all sorts are at famine prices, yet the highly auriferous character of this district renders it attractive.

The *Fraser River* district was the first region to attract the gold miner to British Columbia, and yielded largely in the early days of the gold fever. Official reports say that no deposit of any great extent as rich as those at first worked on the Fraser is again likely to be found, as its valley is quite narrow, and the bars have been well prospected. Chinamen and Indians still obtain considerable gold from the river when the water is low. The first gold known to have been found in this Province was from the Thompson River, near Nicoamen, in 1857, and this locality has continued to yield gold at low water ever since. It is in large particles in crevices among and beneath stones. On the Nicola River, near its confluence with the Thompson, scale gold is found. Tranquille River,

flowing into Kamloops Lake, has afforded occupation ever since 1862, but is now mostly worked by Chinese. The placers on this stream at one time yielded largely. Louis Creek, Vermillion Forks, on the Similkameen, and Twenty Mile Creek, yield fair results. Rock Creek, Mission Creek, and Cherry Creek, especially the latter, are remunerative, the latter yielding above $10 a day per man. In 1877 a nugget worth $130, one worth $90, and another worth $40, were obtained in this claim.

Prof. Dawson gives in his report the names of 110 localities where gold is found in British Columbia. The alluvial deposits have so far absorbed the mining energy of the country, but in view of the diminished yield of the best known placers, and of the inevitable exhaustion within a moderate term of years of deposits of this kind, attention cannot too soon or too carefully be turned to the more permanent quartz mining. Vein mining, if established, would give a more permanent character to mining, and would indirectly tend to cheapen labour by affording steady employment.

In Vancouver Island, the Leech River district, 20 miles from Victoria, attracted much notice at one time, and yielded considerable gold. Small quantities have been found also at Sooke River, Gold Stream Brook, Jordan River, Nanaimo River, in streams falling into Barclay Sound, and near Comox. Owing to the dense forests of the interior comparatively little is known of that section. Gold bearing quartz has been found in Queen Charlotte Islands, at Mitchell's Harbour, but very little is known respecting it.

North-West Territory.—Traces of this metal were found by Dr. Harrington in iron pyrites, a mile south of Great Whale River, and on Dog Island, near Cape Jones. The drift of the Little Whale River Valley also shows indications of alluvial gold.

On the North Saskatchewan gold is found more or less below the mouth of the Brazeau, on the bars and in the river banks, but always in a finely divided state. On the South Saskatchewan specks of it can be washed out from the gravel in the bed of the river, but not in quantities sufficient to pay working. It is more abundant about Edmonton, and is supposed to be derived from the crystalline rocks to the north-east of the point, somewhere between the Methy Portage and Athabasca Lake, some 250 miles distant, and not from the mountains at the source of the river. Prof. Bell says he has been informed by miners who have spent much time in exploring that they have detected fine gold in almost every stream they tried between the two great branches of the Saskatchewan from the longitude of Edmonton to the Forks.

PLATINUM.

ONTARIO.—No traces of this metal have as yet been found in Ontario.

QUEBEC.—Grains of native platinum have been found in small quantities among the native gold of Rivière du Loup and other localities in the same region.

NOVA SCOTIA.—Said to be associated in slight quantities with gold in this Province.

BRITISH COLUMBIA.—On Tranquille River the scale gold is mixed with particles of platinum similar in shape and size to those of gold. On the Similkameen and the Frazer River, 10 miles below Lilloet, fine scales of platinum are found. mixed with gold.

MERCURY, OR CINNABAR.

QUEBEC.—Sir William Logan mentions a white coating of mercurial amalgam often found covering the native gold of the gravel of Riviere du Loup, giving it a whitish appearance, and he also states that globules of running mercury are said to have been met with in washing the auriferous sand of that region. It is observed in like manner with the native gold of Plymouth, Vermont.

ONTARIO.—It is stated by Mr. DeHautefeuille, and quoted in *Geology of Canada* (p. 518), that the native copper from one of the mines of Lake Superior contains, besides a portion of silver, about one part in 4,000 of mercury.

BRITISH COLUMBIA.—Prof. Dawson, in his report 1876-77, mentions grains of cinnabar obtained in gold washing near Boston Road, a specimen obtained by Mr. Tiedmann, of the C.P.R. survey staff, on the Homathco River, and a loose fragment of very rich ore of cinnabar and native mercury found nearly opposite Clinton, on the west side of the Fraser River. Minute globules of mercury are found in some decomposed parts of the Hope silver ores. Prof. Dawson says that he learned that on the Homathco the lode, from from which a specimen of cinnabar was obtained, is well defined and traceable for nearly a mile in length. He says, however, "whether mercury occurs in deposits at all comparable with those of California,

which are found in rocks of similar age to some of those occurring in British Columbia, remains to be proven."

BISMUTH.

Ontario.—Bismuth is mentioned by Dr. Sterry Hunt as occurring in the Township of Tudor, in the County of Hastings. It is found in vitreous quartz veins as carbonate of bismuth near the surface, and as sulphuret, with traces of metallic bismuth, deeper n. Crystalline specimens of the sulphuret, several ounces in weight, are met with ; but this valuable ore is sparsely disseminated. The vein was worked in 1868 for a considerable distance, but want of capital caused operations to cease. The vein is in lot 34 of the third range of Tudor. This is the only known locality in Ontario of this metal.

Nova Scotia.—Specimens of bismuth glance are found in the veinstone of the Eagle Head Copper Mine, and were pointed out by Professor Howe, of Windsor.

New Brunswick.—In Charlotte County, in the Cameron lode of copper, in the Kingston series of rocks, the quartz yielded on assay 10 per cent. of bismuth. It is also found at Eagle Head, Cape Breton.

British Columbia.—Long prismatic crystals of sulphide of bismuth, enclosed in thin veins of quartz, have been found on the north-east side of Little Shuswap Lake.

ANTIMONY.

Nova Scotia.—The Inspector of Mines states this ore is unknown in the Province except as said to have been noticed in auriferous quartz lodes. But, as the Silurian strata holding this ore in New Brunswtck are believed to form part of the precarboniferous system of Nova Scotia, a reasonable expectation may be held out of its occurrence.

New Brunswick. — In the Parish of Prince William, York County, 9 miles north of Harvey Station, on the St. John & Maine Railway, quartz veins holding antimony are abundant, and near Lake George large workings exist. The mining areas are : Lake George,

722 acres; Hibbard, 800 acres; and Brunswick, 450 acres. The report of the Surveyor General of New Brunswick last year, remarking on these mines, says: "Taking into consideration the number, size and extent of the veins of antimony in the neighbourhood of Lake George, and the richness and purity of the ore they contain, this is by far the most promising mining locality yet discovered in New Brunswick, and that these companies should be able to produce antimony at such a low rate and in such quantities as would place New Brunswick among the first antimony producing countries of the world." The analyses given in the same report show a yield from the Lake George Mine of 69, and from the Hibbard of 61 per cent. of antimony.

British Columbia. — Specimens have been found at Little Shuswap Lake.

ARSENIC.

Ontario.—Several localities on Lake Superior yield arsenic in small quantities. An ore from Michipicoten Island contains, besides nickel and copper, from 47 to 53 per cent. of arsenic; another ore from the Wallace Mine, on Lake Huron, yields 6 per cent. It also occurs in the form of arsenate of cobalt in rose coloured incrustations on calcareous spar at Prince's Mine, Lake Superior.

Quebec.—Arsenical sulphuret of iron which contains about 45 per cent. of arsenic is found, well crystallized with argentiferous galena, in a quartz vein on the Chaudière, in St. Francis, and also abundantly in a large vein of quartz on Moulton Hill, near Lennoxville. It occurs also at Harvey's Hill, in Leeds.

Nova Scotia.—Arsenical pyrites is found in small quantities at Eagle Head, Cape Breton.

CHROMIC IRON.

The compound of this mineral used in the arts is the combination of chromic acid with potash, known as bichromate of potash, from which are prepared both red and yellow chromates of lead, the latter known as chrome yellow. A green oxide is prepared from this salt, used for paints, and for the preparation of an indestructible green printing ink. It is used also in dyeing and calico printing. Official reports only refer to it in the Province of Quebec.

QUEBEC.—This mineral is met with in considerable quantities in this Province, chiefly in the Townships of Bolton, Ham, Melbourne, Sutten, and at Mount Albert, Gaspé, where the workable beds are found in the form of disseminated grains, nodules and beds. The ore from Bolton yielded on analysis 60 per cent., and from near Lake Memphremagog 65 per cent. chrome acid.

Sir Wm. Logan says, in the *Geology of Canada*, that the cheapness and facility with which the ore, the potash, and the requisite fuel may be obtained in the Eastern Townships are such as to offer encouragement for the working of the chrome ores in the country.

MANGANESE.

ONTARIO.—At Bachewanung Bay, on Lake Superior, near the south-west end of the Upper Canada Mining Company's location, is a large vein of manganese from 50 to 60 feet wide. It is described as presenting the appearance of a succession of knolls in which are numerous strings of the ore, described by Prof. Hadley as manganite, or sesquioxyd of manganese. It is probable that further explorations will reveal other veins of this mineral in that section.

QUEBEC.—The chief form in which manganese exists in this Province is that known as wad or bog manganese, and it appears to have been formed under conditions similar to bog iron ore. It is more or less mixed with sand or clay, and often contains a large proportion of peroxyd of iron. In Bolton and Stanstead deposits of it exist in patches made up of irregular nodular masses, which when washed from the adhering sand yielded from 26 to 37 per cent. of peroxyd. In the Township of Tring, near its eastern limit, and along the road from Lambton to St. Francis, along the west bank of the Chaudiere River, opposite the mouth of the Famine River, in the Seigniory of St. Mary, manganese exists in patches covering an area of a few yards and varying from 2 inches to 2 feet in thickness. At La Plaine, in the Seigniory of Cacouna, and in the neighbourhood of Quebec, on the St. Louis Road, are deposits of earthy manganese, in the form of black porous masses imbedded in sand. Prof. Harrington examined specimens from the Township of Cleveland, but after careful separation of the rocky particles the product which passed through his sieve only yielded 15 per cent. of peroxyd.

NEW BRUNSWICK.—In this Province manganese is for the most part confined to the lower carboniferous beds, and in King and

Albert Counties the principal deposits are found near the contact of the silurian and carboniferous rocks, as at Shepody Mountain and Markhamville.* It occurs also at Hillside, Little River Valley, Albert County, and a little west of Hopewell Corner, along the road to Germantown. Near Cape Enrage, in the eastern part of Salisbury Bay, workings existed some years ago, but are now abandoned, and at Queen's Head a rich deposit exists, but not yet developed. At Hopewell Corner a small deposit was soon exhausted and no further prospecting made; at Petitcodiac and Jordan Mountain there are good surface indications. The same remark applies to Henry's Lake, where it is also found.

Nova Scotia.—This ore is met with throughout this Province wherever the lower carboniferous strata occur, especially in Cumberland, Pictou, Colchester, Hants and Kings Counties, in strings and nodules. Near the Pictou iron deposits it has been found in masses weighing up to 200 lbs. In Hants County an irregular annual export has been maintained, amounting since 1861 to about 2,000 tons, valued at $110,000. Formerly extensive operations were carried on at Teny Cape, Walton and Pembroke, but are now only continued at the first mentioned locality. The Hants County ores are very high class, yielding from 90 per cent. and upwards of peroxide, and, being almost free from traces of iron, are valued by the flint glass maker, as glass is apt to contract a greenish tinge from the presence of iron. It is also used for black enamel for pottery, tiles, etc., in calico printing, and in many other industrial applications. In Onslow, Colchester County, six miles from Truro, it is present in workable quantities, and in Pictou County, on East and Middle Rivers. The manganese yielding district in Hants County, which gives promising indications, is over 150 square miles in extent, and the absence of workings may be traced, not to a deficiency of the ore, but to want of enterprise and capital. Bog manganese from Boularderie Island, Cape Breton, the only form in which it has yet been found there, gave an assay of oxide of 44 per cent., as stated by the Inspector of Mines, who adds, in his report of 1880, that, "were the deposits of this Province tested and carefully prepared for shipment, they could be made a very profitable article of export."

* The latter is, so far as known, the most important, and has long been worked, with varying success, since 1863. Owing to the distance of the mine from railway connection (11 miles), cartage is a heavy outlay, but the price obtained for the ore at Sussex is from $15 to $50 per ton, according to quality.

North-West Territory.—Along the east coast of Hudson Bay, Prof. Bell states the whole chain of Nastapoka Islands contain manganese. A specimen from Flint's Island assayed 24 per cent. of carbonate of manganese, and he thinks the black oxide may be reasonably looked for there as a sequence. The high percentage of manganese in the iron ores of all this district will, he says, render them valuable, and owing to their abundance and accessibility they may some day be found worth carrying to Europe or the United States. The islands being destitute of timber and the rocks much shattered by frost the ore, ready broken, may be gathered up in inexhaustible quantities, and as the islands afford good shelter for vessels, the ore might be conveniently loaded in many places.

MOLYBDENUM.

This comparatively rare metal is used for dyeing purposes and calico printing, but, although existing here, it has not yet been worked. The native sulphate is worth about $3.50 per lb.

Ontario.—It has been observed in small quantities in a quartz vein at Terrace Cove, on Lake Superior, at Mud Lake, and near Balsam Lake. Traces of it have been found in numerous mining localities on Lake Superior, but as yet in no quantity.

Quebec.—The Manager of the Mining Company at Harvey Hill, Leeds, reports sulphuret of molybdenum existing there in veins of quartz and spar intersecting the copper bearing slates. It forms small masses, rounded in their outline. It is in that locality granular, soft, and assumes a polish when rubbed with the nail. On the north shore of the Gulf of St. Lawrence is so far as known the only available quantity of this mineral is to be found at Quetachoe, Manicougan Bay, where it occurs in a bed of quartz disseminated in nodules 1 to 3 inches in diameter, and in flakes sometimes 1 foot broad by a quarter of an inch thick. It presents a leaden grey colour, is soft, unctuous to the touch, and is apt to be mistaken for plumbago. It can be distinguished from the latter by its greater weight and by a peculiar greenish hue in the metallic streak it leaves on white paper.

Nova Scotia.—This metal is found at several places in this Province, such as Hammond's Plains, Lower Musquodoboit, and at Lunenburg. It has been found also at Gabarus and Louisburg, in Cape Breton.

North-West Territory.—Prof. Bell states, in his report on the east coast of Hudson Bay, that he was presented with a specimen of molybdenite found in the neighbourhood of Great Whale River.

British Columbia.—Prof. Dawson, in his report, 1877-78, mentions molybdenite in association with copper ore at a locality between Jarvis Inlet and Howes Sound, and speaks of a specimen brought from the upper part of the Corvitchen River by Mr. W. Robertson.

APATITE, OR PHOSPHATE OF LIME.

This is a common mineral in the limestones of the Laurentian rocks, sometimes disseminated in minute blue or green crystals, and at other times so abundant as to make up a great proportion of the rock, and in some cases to form beds of a nearly pure crystalline apatite. Of late years the increasing demand for phosphates as fertilizers of the soil has drawn attention to the use of this mineral in a prepared form, and the large supplies existing in Canada are now receiving considerable attention.

Ontario.—In his report on the County of Hastings, Mr. Vennor, of the Geological Survey staff, in 1871, called attention to large workable deposits of phosphates existing there that had been quarried on and off for over twenty years, which he denominated as "The North Burgess Phosphate Basin" and "The Bedford, Storrington and Loughboro' Basin." The former of these extends through the Townships of North Burgess, South Crosby and Bedford, and was found to have a thickness of from 2,600 to 3,000 feet, forming a belt or zone running from the north-east to the south-west corner of Burgess, south-westward through Crosby. The latter runs through the south-east corner of Bedford Township, and on through the Townships of Storrington and Loughboro'. The width of the basin is about 6 or 7 miles, and narrows in places to half that width. The available deposits of phosphate appear to occur towards its outer side. The richest deposits of this mineral occur in the Township of North Burgess, where a large number of phosphate mines or "openings" are worked, with very fair returns. Of these, 145 in number are described in Mr. Vennor's report (*Geol. Survey*, 1873-74). Phosphate is met with more or less all through the district lying north of Kingston and Belleville, and analyses made from specimens taken in different localities gave on an average 88 per cent. of phosphate of lime.

Quebec.—Mining for this mineral in the Ottawa district of this Province is of comparatively recent date, and is carried on in the Townships of Buckingham, Templeton, Portland and Hull. In the former the apatite is confined to a line of rock running in a north-easterly direction from the Blanche River, near the centre of Templeton, through the north-western corner of Buckingham, across the Aux Lievres River, through the south-east corner of Portland, into the centre of Derry Township. The belt is very productive, and yields a very fine quality of apatite. All the mines of any importance are on this belt. In Portland, the Buckingham Mining Company own several lots, and have made numerous openings, all of which yield abundantly. The apatite is of a beautiful bluish green crystalline appearance, but the deposits are irregular and cannot be depended on one yard beyond what is actuallyseen. Layers of it 2, 3 or 6 inches thick are observed in the distance of a few yards to expand into masses measuring several feet in thickness, which on further stripping as suddenly disappear. Abundance of black mica accompanies the deposits here, but, from its colour, is of no economic value. In Buckingham Township the Buckingham Mining Company are working a number of openings, and, in addition to large bed like deposits, a large part of the mineral is in the form of crystals. It is sometimes much discoloured with rust, due to the presence of iron pyrites. This latter feature at one time it was feared would lessen the market value, but specimens of a most unpromising appearance examined and analyzed by Professor Chapman returned an exceedingly high percentage. None of the deposits are regular or well defined, and are only discovered by haphazard workings. Mr. Gerald C. Brown, who has had much experience in phosphate mining elsewhere, has been actively engaged in the Buckingham district. He worked lots on the north-east side of the Aux Lievres River, in Ranges 9 and 10. In the latter there is a mountain, known by the name of "Burnt Mountain," of rotten rust coloured gneiss, in which apatite largely exists. South of Range 10 no workable deposits have been found, although apatite crystals are met with. From lot 25 in Range 10 apatite shows in scattered surface exposures in lots 1, 2 and 3 in Range 12 of Templeton, whence the belt takes a southerly course towards the Ottawa River, and a deep covering of soil precludes prospecting. On the north-eastward extension of the belt from Buckingham, however, and through the south-western portion of Derry, the country is high and mountainous, and the rocks favourably disposed for prospecting. It should be borne in mind that the apatite bearing rocks do not extend for an interminable distance north-eastward, but soon after entering Derry, turn north and westward, returning to the Aux Lievres

River and cross to the opposite shore some distance below the "High Falls," immediately north of the Township of Portland. The cost of mining and transport to England of this mineral from the Buckingham district is about $13 a ton. In the Towships of Hull and Wakefield apatite is largely found, and the workings and openings are almost innumerable all through this district. The quality of the mineral in these townships is excellent. Huge crystals of apatite have been met with in various workings, the most notable of which was one several feet in height in the mine on lot 17, range 9 of Templeton. Professor Harrington mentions one in the same mine which he saw, 2 feet 9 inches in length and the same in diameter. A large crystal from this section was exhibited at the Philadelphia Exhibition.

As a rule the apatite bearing veins of the Ottawa region are characterized rather by a want of regularity or order in the arrangement of their constituents than by any degree of symmetry. Occasionally instances are met with where the veins show a distinct banded structure. The following analyses of samples from various mines in the Ottawa district are given by Professor Hoffman, (*Geological Survey*, 1877-8): Grant Mine, lot 18, range 12, Buckingham, 89 per cent. phosphate of lime, Ritchie Mine, Portland, 89 per cent. Watts' Mine, Portland, 88 per cent. "Doctor" Pit, lot 12, range 12, Templeton, 89 per cent. Prof. Hoffman considers, from its usual high constituent of phosphate, Canadian apatite may be regarded as a most eligible material for the manufacture of a concentrated superphosphate; generally speaking it contains only small quantities of oxide of iron, and generally the amount is quite insignificant. All the Canadian apatite hitherto met with belongs to the variety fluor apatite, and is very similar in composition to that derived from many European localities.

To give an idea of the activity prevailing in the phosphate districts at the time of writing this, the following notes are quoted from a correspondent who visited Portland Township to ascertain the actual condition of the mining interests there :—

"Never in the history of this district has the Lievres River been the scene of such business activity as at present. Phosphate mining has already developed to such an extent in Portland and Buckingham that it promises at an early date to throw the lumber interests completely in the shade. At present there are as many as 250 teams employed daily in hauling phosphate from the mines to Buckingham, and the ice track on the River Du Lievres presents more the appearance of a busy street than a stream running through a wilderness. The High Rock Mine employs one hundred and forty-

seven teams ; the Preston Mine has some twenty teams, the Murphy Mine, the French Company Mines, the Haycock, the Murray and other mines, are all sending out large quantities of ore. The High Rock Mining Company are opening up the Dugway Mine, known as 'the mother vein.' They have commenced operations on this vein with a force of twenty men, and they are blasting out phosphate of a very superior quality. The teams employed are paid for hauling by the ton, the rates being from $2.65 to $2.75 per long ton, the teamsters boarding themselves and their horses. The Liverpool *Journal of Commerce* of a recent date quotes phosphate at 30c. per unit, which would be equal to about $25.50 per ton for High Rock ore. There will be at least $15,000 paid out on the Lievres this winter for freighting for the mines alone, and there are scores of mines to be opened yet as soon as there is any prospect of the projected railway being built. The French Mining Company are said to be taking out less phosphate for the money expended than any other miners on the Lievres, owing to inexperience in the management and injudicious purchases. It is to be hoped that this profitable industry will not be injured, as many other Canadian mining enterprises have been, by want of good business management."

At River Ouelle, on the Lower St. Lawrence, small phosphate nodules are met with (*Geology of Canada*, p. 462), but not in sufficient abundance to be of commercial value. One of these assayed by Dr. Sterry Hunt yielded 40 per cent. of phosphate of lime.

New Brunswick.—Apatite has not yet been discovered in this Province, but the calcareous sandstones of the Acadian group at St. John are blackened with phosphatic matter.

Nova Scotia.—Mr. H. Fletcher, of the Geological Survey, mentions layers of phosphate nodules as met with at Macintosh Brook, Cape Breton. If these are found to exist in any quantity a valuable fertilizer could be manufactured for local use, and it would be well to prospect this vicinity for further information.

GYPSUM.

Ontario.—The geological formation producing gypsum extends from the Niagara River to Saugeen, on Lake Huron, a distance of about 150 miles, but the chief gypsum mines are on the Grand River, from Cayuga to Paris. It occurs in beds from 3 to 7 feet in thickness. A large deposit, which has been extensively worked,

occurs some three miles from the Village of Cayuga, on the left bank of the Grand River, and several other deposits are in the same vicinity, all yielding large returns. It is very pure, and well fitted for the purposes of cement and stucco.

New Brunswick.—Large deposits of gypsum exist at Hillsborough, in Albert County, whence enormous quantities are removed. Snow white alabaster is met with associated with the red sandstone holding the gypsum. At Petitcodiac, Westmoreland County, a large deposit of gypsum, with a breadth of about 40 rods and a total length of one mile, is worked for local use, and the same at Tobique River, Victoria County. In the first named locality it is fibrous and crystalline, and traversed by a vein of nearly pure selenite eight feet wide through its entire extent. At Hillsborough the material is calcined for application to the land, and largely exported as plaster. With the exception of a short cessation consequent upon their destruction by fire, works have been in continuous operation since 1861. Their productive capacity is about 600 barrels per day.

Nova Scotia.—The deposits of gypsum in this Province are on an unequalled scale. In Antigonish it occurs as a crystalline cliff, 200 feet high on St. George's Bay, and similar exposures are met with at Plaster Cove, Mabou, and on the Bras d'Or. The chief localities yielding it are Windsor, Cheverie, Maitland, Walton, Hantsport, Wallace, Antigonish, Mabou, Port Hood, Port Hawkesbury, Bras d'Or Lake and in Pictou County. At Boularderie Island gypsum whitens the sea cliffs in several places. A large deposit of gypsum exists at Port Bevis, near Baddeck, on which several quarries have been established, with a large annual yield. The chief quarry is some four miles east of Baddeck, near the shore of Bras d'Or Lake, with which it is connected by a railway and wharf. The material from this quarry yields about 98 per cent of gypsum. The gypsum is ground for local use at a number of small mills. At many points in the Province, as Antigonish and Windsor, the transparent pure variety of gypsum, commonly called isinglass, and known to the mineralogist as selenite, can be procured in large quantity, and also pure massive white gypsum.

North-West Territories.—Prof. Macoun reports meeting with fine white gypsum cropping out for 20 miles from the Rapid Bouille, on the Peace River. In many places the beds attain a thickness of from 10 to 15 feet, as clear and white as snow. The banks of the river and the islands from the Rapid to Peace Point show gypsum in abundance. In the clay banks near Forts Ellice

and Pelly selenite is met with in abundance. Prof. Bell says that on the Main Moose River, 35 miles above Moose Factory, "white or gypsum banks" are met with. The gypsum is in the form of lumps, but the white variety suitable for stucco was not observed in sufficient quantity to be of economic value. He says some of it much resembles the beds in the Onondaga formation of the Saugeen River in Ontario. For future agricultural purposes in the North-West these beds may be found of great service.

GRAPHITE, OR PLUMBAGO.

Although not a metal, plumbago, or black lead, as it is commonly called, possesses and imparts a bright metallic lustre. Mixed with oil, it is used as a paint for iron vessels; iron founders use it for dusting their moulds; it is used to counteract friction in machinery movements; for pencils and stove polishing purposes it is well known; but of all its uses the chief rank must be given to the manufacture of crucibles. For years Ceylon supplied the world with plumbago; the celebrated Cumberland mine in England is well nigh exhausted, after having been worked for over 100 years. The United States have of late years taken fair rank in its production, but it is in Canada that deposits of plumbago exist, which have only been tested, as the operations carried on can scarcely merit the name mining, but the richness and purity of which, and freeness from lime—an impediment detrimental to the manufacture of good crucibles—if properly developed, would place Canada, if not in advance of Ceylon, at least before all other countries of the world now producing this mineral. Its abundant existence throughout an immense extent of the Laurentian rocks is conclusively established. In some places it is found pure in veins and masses, in others disseminated through the rocks.

Ontario.—Traces of this mineral are met with in the rocks of the Lake Superior district, but very little is known of its existence there, and it is doubtful if any large veins exist in that locality. It occurs disseminated very generally through the Laurentian limestones in the rear of Kingston, in the Counties of Hastings and Frontenac. The Townships of Burgess and Loughborough both yield it, and in North Elmsley a mine of plumbago has for years been worked, the mineral being found in thickly disseminated scales in a sandy calcareous rock. In the Township of Bedford, on Bird Lake, and at Mud Lake in Loughborough, veins of it exist.

Very little has been done in the way of developing this mineral in Ontario, but Sir William Logan states that it is probable this section (rear of Kingston) will be found to yield in many localities valuable deposits of plumbago.

Quebec.—In the County of Ottawa plumbago occurs in a great number of localities, but especially in the Townships of Grenville, Lochaber, Buckingham and Templeton. It is found in three distinct forms, viz., as disseminated scales or plates; as lenticular or disseminated masses embedded in limestone, and as fissure veins cutting the enclosing strata. The first form is that most commonly met with, and occurs in greatest abundance in the limestones, often to such an extent as to constitute deposits of great economic value. The second form, that of embedded masses, is of common occurrence, and in Buckingham, Lochaber and Grenville is met with and has been worked to a small extent. In Lochaber Township a bed over 10 feet in thickness has been mined. The third, of fissure veins, is not so common, and though of much greater purity and brightness cannot be worked to such profit as the other forms. Mr. Vennor, in his report of 1873-74, says "it is to the bedded deposits of this mineral that we must look for our chief supplies," and Sir William Logan, in the *Geology of Canada*, remarked: "The veins hitherto found in the rocks of this country appear to be too limited and too irregular to be exclusively relied on for mining purposes, which should rather be directed to making available the large quantities of graphite as disseminated." The latter are well developed in Buckingham and Lochaber.

It is said that plumbago was mined to a small extent in Grenville, as long as thirty years ago, by some Scandinavian settlers, and that farmers around Buckingham used the purer specimens which they picked up for polishing their stoves. No mining, however, worth speaking of was done until a New York Company opened a mine in Lochaber, where they purchased a number of plumbago deposits and erected factories, but after working several years ceased operations. A Montreal Company commenced operations about the same time, on what is known as Twin Lake, and a small settlement, called Ceylon Village, quickly sprang up. A large mill was erected at the junction of Twin and Donaldson's Lake, the ore being carried to it in scows, into which it was shot from the mine on the hill summit by means of a long inclined trough resting on trestles, similar to a timber slide. This hill rises abruptly from the lake to a height of about 350 feet, and on its summit a large bed of disseminated graphite was worked, about 300 or 400 feet wide and some 25 feet deep, before sinking shafts. At this depth two of these were sunk

about 30 feet, at a distance apart of 200 feet, and a third shaft about 70 feet deep. A large amount of plumbago was extracted both from the disseminated bed and from the deepest vein shaft. In 1875 the mill was unfortunately burnt, when bush fires swept that section, and work was then suspended. Difficulty of transportation was one main cause of the failure of this company, and this although somewhat remedied is still a source of great trouble and expense to all miners in the back country. Very large quantities of "dome" stove polish were manufactured at these works, and large shipments were made both to England and New York.

Subsequently the Dominion of Canada Company went into operation at Devine's Lake, with a large capital and every appliance that could then be brought to bear on this industry. Their claim covered 2,000 acres of land containing very rich deposits, and 15 lodes or rich veins, one of which in lot 21, concession 7, was stated by Vennor to vary in thickness from one to two feet. The deposits of disseminated mineral were found to be more easily and profitably operated. The mine or quarry was an eighth of a mile long, 70 feet deep, and yielded from 10 to 60 per cent. of plumbago. The machinery used at the mill was capable of turning out about 15 tons per week. A small settlement sprang up at these workings known as Graphite City, and everything prospered for a time, till owing to the late commercial depression the company suspended operations. One of the principal reasons was that the diminished production of iron caused a great decrease in the demand for plumbago crucibles for steel smelting, and prices consequently dropped from $250 to $75 per ton, and even less. From the fact, however, of the revival of the iron industries, and the consumption by one English firm alone of 8,000 tons of plumbago a year for manufacturing crucibles, there is *every prospect of a good and speedy demand, at profitable prices*, for Canadian graphite.

A large number of smaller mines were worked by individuals in Buckingham and Lochaber Townships, but want of capital was the reason of their ultimate suspension. The graphite obtained there is remarkably pure, the Dominion Company claiming that their purest material contained 97 per cent. carbon. The process of manufacture is peculiar and can be described in a very few words. When received at the mill it is broken into lumps of about 3 lbs. weight and then crushed. It is afterwards separated into different grades by passing through tubs of water, where, circular brushes keeping the mass rotating, the materials are separated, according to their specific gravities, in rings around the centre. The graphite being the lightest gradually reaches the outer ring, the heavier stony matter remaining in the centre. It is then dried in an oven,

ground and separated, the coarse grades being packed in barrels for crucibles, and the finer for polishing and otherwise.

The County of Ottawa plumbago district must sooner or later again be worked for this mineral, and the deposits it it are so rich, as proved by the work already gone through, as to hold forth every inducement to future capitalists to embark in this industry, with every prospect of fortune.

An exhibit of plumbago from the Ottawa district at the Philadelphia Centennial Exhibition was pronounced unequalled.

In the Eastern Townships plumbaginous slates are met with at Owl's Head, and in Granby, Melbourne and St. Henri, but existing nowhere in sufficient quantities to be of economic value. They are a continuation of the true plumbago deposits in Massachusetts.

Analyses of the Buckingham disseminated graphite made by Prof. Hoffman yielded 22, 23, 27 and 30 per cent. respectively of graphite; vein graphite from the same district yielded 97, 99, 99, giving the same results as assays made on Ceylon graphite at the same time, and a little above the assay of a specimen from Ticonderoga, State of New York, which yielded 96 per cent.

New Brunswick.—In Charlotte County beds of graphitic slate are common in the south part of St. Stephen, the north part of St. Patrick, and near Dumbarton Station on the St. Andrews and Quebec Railway; but it is only at the latter locality they appear sufficiently rich in graphite to give any promise of being valuable, economically. On the hill south of the station there are pockets of graphite sufficiently pure to be available for lubricating purposes or for stove polish. (*Geol. Can.* 1876-77 p. 329.) It is not unfrequently disseminated in a finely divided state through the more altered rocks of the southern counties of the Province. The largest of these are in connection with the rocks of the Laurentian system in the vicinity of St. John, appearing at the Narrows of St. John River, Lily Lake and other points. At the old opening at the Falls, known as "Split Rock Plumbago Mine," the facilities for mining and shipment are good. This mine has been worked and abandoned from time to time in a very irregular manner; considerable quantities have been taken out since its first opening. Its product yielded on assay 48 per cent. graphite, and was pronounced to be of fair quality and adapted for the manufacture of the commoner kind of lead pencils.

Nova Scotia.—This mineral is not uncommon in this Province, although as yet no deposits have been worked. Among the localities affording it may be mentioned Parrsborough, Salmon River, Glen-

dale, Musquodoboit, Hammonds Plains, Boularderie Island, Gregna Brook, and Gillis Brook, Cape Breton. The deposits are in many places really highly plumbaginous shales, but the Inspector of Mines in his report for 1880 says: "were attention directed to the subject some might be found of economic value." An assay of disseminated graphite from Glendale, Inverness County, gave 13 per cent. graphite.

British Columbia.—A specimen of plumbago was brought in by the Vancouver Island exploring expedition from the district north-east of Port San Juan.

North-West Territory.—Plumbago is not mentioned in any official reports of this district, but it will probably be found to exist among the other minerals on Hudson Bay when further explorations have been made.

ASBESTOS.

What is commercially known as asbestos is really a term used to denote a peculiar fibrous form assumed by several distinct minerals, rather than to designate any particular species. Tremolite, actinolite, and other forms of hornblende and serpentine, passing into fibrous varieties, assume the name of asbestos, and the *Geology of Canada* does not give the mineral as a distinct one, but recognizes it under these different headings. As yet comparatively little asbestos has been found in Canada, and the few discoveries that have been made are of the variety known as chrysolite.

Ontario.—The serpentine and hornblende in the country back of Kingston is spoken of in the various Geological Survey reports as being of the fibrous kind, but no asbestos workings are mentioned. The rocks of this portion of Canada probably possess the mineral, but whether in sufficient abundance to prove workable is not yet known.

Quebec.—The principal source of the Canadian asbestos of commerce is a narrow band of serpentine in the Quebec group, in this Province, a series of rocks at the bottom of the Lower Silurian formation, and which runs from the Vermont boundary of the Eastern Townships to the River Chaudiere, through Potton, Bolton, Orford, Brompton, Melbourne. Shipton, Cleveland, Ham, Garthby, Coleraine, Thetford and Broughton.

There is a mine in operation at Shipton, near Danville, from which a large quantity of asbestos has been procured and sold at $60 per ton. The output of this mine for the next ten years has been contracted for. The most successful mine of the kind was opened in Coleraine, in 1877, and is owned by the Boston Packing Company, and its yield is pronounced by European manufacturers as the finest and strongest fibre of the kind known. The tract of land yielding it is three miles long and one mile wide. A good quality of asbestos has been found in Shefford on the line of the Quebec Central Railway, which deposits Prof. Selwyn pronounces very promising. At the Chaudiere River good specimens have been obtained, and a small quantity has been exported from the Des Plantes River, one of its tributaries. The price averaged at the mines in this district was $50 per ton, and there is *no question as to the profitable nature* of asbestos mining in that belt of country.

In the Laurentian rocks several tons were taken out some years ago in the Papineau Seigniory, near St. Andre Avelin, but the workings were abandoned. It was said to have been used in the manufacture of lampwicks in Rhode Island, but the probable exhaustion of the vein without prospecting in the vicinity for other traces led to its abandonment. In Templeton, Lots 10 and 11, Range 8, there are two contiguous workings, the fibre ranging from a fraction of an inch up to 3 inches, this constituting the width of the seam. One ton from these mines, shipped in 1879, realized $100 per ton f.o.b. in Ottawa. Traces of asbestos are to be met with at Chelsea and on Meech's Lake, and through the hills running north of Ottawa City.

The opinion prevails amongst geologists that the mining of asbestos in the Ottawa Valley is destined to become an industry of some importance.

Nova Scotia.—Fibrous hornblende is met with in the rocks composing the Cox heath, Boisdale and St. Anne Hills, Cape Breton. At Morrison's Brook it is spoken of as occurring, as well as at Macdonald's and Rocky Brook, a small tributary of George River. No true asbestos seams, however, occur.

North-West Territory.—Prof. Bell, in his report on the east coast of Hudson Bay, says asbestos is found in small quantities one and a half miles south of Little Whale River. It was described to him as occurring in large quantities elsewhere on the coast, but the localities were not ascertained.

COAL.

That coal does not exist in Ontario or Quebec, owing to the geological formation of these Provinces, is an established fact; but being situated favourably in their proximity at all points to other carboniferous regions, and the facility of conveyance afforded by the vast lakes, rivers, canals and railways of the respective Provinces, it is easily procurable, and the deficiency is well made up by the vast areas of coal district in the Maritime Provinces, and on the Pacific Coast. It is a most important matter for Great Britain to hold on either side of her possessions in this continent countries possessing this valuable mineral on the coast, the eastern and western portals of the Dominion.

Nova Scotia.—It is probable that Nova Scotia, in proportion to its extent, stands unrivalled in the productive capabilities of its coal fields, whilst nature has afforded every facility for working them to advantage. The coal belongs entirely to the bituminous division, no anthracite having been met with as yet, although there are numerous tracts of carboniferous formation in various parts of the Province; the largest and most valuable are situated near and along its northern shores, and over a considerable portion of the northern and eastern shores of Cape Breton.

For the purpose of conciseness the following order is given of the different coal fields, viz: Cape Breton, Inverness, Richmond, Antigonish, Pictou, and Cumberland, and the details are compiled from the report of the Inspector of Mines for 1880, with other notes from Geological Survey Reports.

Sydney Coal Field.—Mr. Robb estimates the area of the productive coal measures of the Sydney coal field at 200 square miles, being about 32 miles long and 6 miles wide, limited on three sides by the Atlantic Ocean. This coal field forms the southern extremity of an extensive area for the most part hidden under the ocean, but nearly all the seams can be followed, and mining rights have been taken out covering above 100 square miles of the submarine coal. Mr. Poole, in a report to the Commissioner of Mines, says that, assuming a line of three miles from the shore to be the boundary of profitable working, 4,000 feet the available depth, and no seam under three feet thick to be worked, and taking into consideration all geological facts as ascertained from other coal yielding investigations elsewhere, the submarine coal field of Cape Breton *is capable of yielding 1,866,000,000 tons.* The exceptional freedom from faults which characterizes this coal field has been strongly dwelt on by all engaged in exploring it. The Lloyds Cove seam was opened by the

General Mining Association some years ago, and workings were extended over about 18 acres, but, it being found that the Main seam could meet all demands, it was abandoned. The same remarks apply to the Hub seam, whose land area is 150 acres, 60 of which have been partially worked out. The coal from this seam is well adapted for gas making. The Harbour seam has been extensively worked by the Block House, Little Glace Bay, International, Victoria and Sydney collieries, and is largely used at the New York and Boston gas works. It has also been proved a good steam coal. At Little Glace Bay this seam has been opened at a lower level, and the quality of coal found to improve. At the International Mine the yield is used chiefly in New York for gas, and is well adapted for locomotive work, from tests made. At the Victoria Mine it is more compact, and is better adapted for steam and house fuel, and has never been known to heat in cargo. At the Sydney collieries this seam has been proved excellent for steam and domestic use, retailing in Halifax at from 30 to 80 cents higher per chaldron than any other Cape Breton coal. The Bouthilier and Back Pit seams of Glace Bay, and the Mill Pond and Black Rock seams of Boularderie, vary in thickness from 3 to 6 feet. In the presence of the larger seams, they have been but little worked, and may be looked upon as an important reserve. The only opening made on them is at Cape Dauphin, the product finding a market in Halifax and other places for house use.

The next seam, known as the McAuley, Phelan and Lisgar, is worked by the Gowrie, Ontario, Caledonia, Reserve and Lingan Collieries. This bed has furnished a large amount of coal, and may be considered the typical seam of the district. At the Gowrie colliery it is 5 feet thick. It is used for steam and domestic purposes, and has been found well adapted for iron working. At the Ontario and Caledonia Mines this seam varies its character slightly, and though still a good coal becomes rather more free burning. The Caledonia coal has been largely exported to the New England States for steam and gas purposes, for lime burning and for house use. At the Reserve Mine it forms one of the handsomest coals, and is used chiefly for steam purposes. It is sent largely to Newfoundland, where it is in demand for steamers, which require a coal capable of raising steam quickly. At Lingan, this seam laid the foundation of the gas reputation of Cape Breton coal in the United States. Large quantities have been sent to New York and Boston for this purpose.

The next, or South Head and Spencer, seam has been opened at all points in the district, but operations at present are suspended. It yielded well for gas purposes from a sample cargo. The yield from

the Schooner Pond, Emery and Collins collieries is reported of excellent quality for the same purpose.

The lowest seam is the Lorway or Gardener, and has been worked at the two mines of these names.

The coal is good for steam purposes, and well adapted for ships' use.

Little can be said yet of the seams underlying the former, as they are known only by pits and natural exposures.

From the above it will be seen that the Sydney coal field furnishes coal particularly suited for gas making, and certificates from the English mercantile navy prove it almost equal to Welsh steam coal. The enormous amount of available coal it contains is stated by Geological Survey Reports to be over 212,000,000 tons. The cost of the coal mined and put into the cars varies at the different collieries from 60 cents to $1.25 per ton.

Inverness Coal Field. — From Cheticamp to Judique, on the western shore of Cape Breton, there extends a narrow and broken line of coal measures, forming the edges of great basins of coal beneath the Gulf of St. Lawrence. At Chimney Corner two groups of seams exist, and at Broad Cove eight seams in about 2,000 feet of strata, one only of which is worked. The extent of productive measures here is not known positively, but areas containing twenty square miles, believed to hold workable coal, have been secured by various parties. The Geological Survey Report of 1874 says: "Judging from appearance, this coal, which is of the bituminous kind, seems to be of excellent quality." It has been satisfactorily tested for steam and house purposes.

Another small but valuable coal field exists at Mabou.

At Port Hood one seam only has been definitely tested, though the presence of several others has been proved. Here the strata run parallel with the shore, and extend along it for about two miles. The seam opened has a thickness of six feet. Workings were pushed a short distance under the sea, but are temporarily discontinued. The outcrop of another six foot seam is known at low water. Owing to the rapid wearing away of the shore, traces of many seams will soon become obliterated, and in proof of this Seal Island may be cited, which, composed of carboniferous strata, and once beyond doubt connected with the mainland, is now separated by a channel two miles wide. Port Hood is another instance of the wasting powers of the Gulf.

Richmond Coal Field.—This district is considered to extend from a point eight miles above the new bridge on the River Inhabitants to Little River and Sea Cove Bay on the west, and Coal Brook on the east side. The seam includes one of a thickness of eleven

feet, and two others four and five feet thick respectively. At Richmond two seams four feet thick have been opened. Others are reported, but not much is known respecting them.

Antigonish Coal Field.—A small field was found a few miles north of Antigonish a few years ago, and work enough carried on to show the presence of five seams of coal. It is said to be of fair quality, but there is not demand enough to render its working necessary at present, especially as the Pictou coal is carried through the centre of Antigonish County by the Halifax and Cape Breton Railway. The coal area of Antigonish is estimated at from five to ten square miles. It may be looked upon as a reserve for future working, if an extra demand arose for any special industry.

Pictou Coal Field.—This district lies immediately south of the town of New Glasgow, and its area may be estimated at about 35 square miles. Owing to the unusual size of the beds, it contains a large amount of coal. The seams are divided into an upper and a lower group, the upper containing those known as "The Captain," "Millrace," "McKay," "McBean," "Pottery," and "Stewart McLennan." The product of all these is of excellent quality, the "McKay" being especially suitable for gas manufacture. The "McBean" has proved well adapted for steam raising in marine and other engines. There are four companies working in this district. The collieries are large, well equipped, and equal to an annual output of from 75,000 to 250,000 tons.

The lower group of seams has been extensively worked to the west of East River, and the seams are known as "Main," "Deep," "Third," "Purvis," "Fleming," "McGregor," "Stellar," "Seam A," and "Seam C." The Main seam has been worked for many years at the Albion Mines by the Halifax Coal Company and their predecessors. The Acadia seam of Westville is considered to be, if not an extension, at any rate an equivalent of the Main seam. The coal from the Albion Mines is an excellent steam coal. At the Intercolonial Colliery it is of a similar character, well adapted for steam purposes and for house fuel, for which latter use it is especially prepared. At the Nova Scotia colliery the yield is very similar, and it has been extensively exported for the same uses to the United States. The "Deep" seam has been worked only at the Albion Mine, whence large quantities have been exported for steam purposes and iron working. The "McGregor" seam was formerly worked by the Acadia colliery, and was considered specially adapted for steam purposes, whilst the "Stellar" is a very high class of cannel coal, known as stellarite, and is overlaid by fat bituminous coal, and oil shale underneath it. This material is well adapted for a gas enricher, and in practical working at the

mine 60 gallons of crude oil and 25 of refined per ton of coal were obtained. There are several other beds of oil shale in this coal field, but they cannot be worked with profit in the presence of Canadian and American oils.

Cumberland Coal Field.—This is the most westerly situated of the coal fields, the South Joggins shore of which has obtained a well deserved geological fame. In its cliffs there is exhibited an extended section of carboniferous strata which is, perhaps, unequalled. For a distance of nearly ten miles along the shore, bed after bed is exposed, to an aggregate thickness of upwards of 14,000 feet. Operations have been conducted here for a number of years, the first openings being made at the Joggins. The coal has been extensively used at St. John and other ports as a house and steam coal. At the River Hebert a five foot seam has been opened, and at Maccan two seams of four and two feet have been found. At the Scotia and Chignecto properties a seam is worked lower than the above mentioned seams, giving a section of nine feet six inches as measured in a new tunnel of the latter works. The coal is burnt locally, and well liked.

The most easterly opening in this district is the Styles Mine, the coal of which is eight feet thick and of good quality. From the shore to Spring Hill little is known of the geological conditions of the country.

At Spring Hill eight seams occur, and the extensive works are carried on by the Spring Hill Company. The yield is compact, bright and clean. The disadvantages of this district are not being so near shipping places as other collieries.

At many other localities besides the above mentioned coal fields, discoveries of this mineral have been made, but the seams have not been considered of economic value. Amongst these are the North River, of Truro, and the Folly Mountain. Dr. Dawson says: "Outcrops of seams, varying from one to two feet in thickness, have been found at several places along the base of the Cobequids as far as Cape Chignecto. Indications of coal have also been observed in the band extending from Lower Stewiacke toward and along the Kennebcook River." At Hunter's Mountain, New Baddeck, Loch Lomond, Salmon and Gaspereaux River, Nests Cove and other localities, small seams crop out, but are not regarded, so far as explorations have been carried on, as of any present value. The known productive coal fields of the Province occupy an area of about 685 square miles, of which the Sydney and Cumberland fields comprise 600 miles; the remainder being divided between the Pictou and the smaller fields of Antigonish and Cape Breton.

New Brunswick.—Within the last few years considerable money has been spent in developing a seam of anthracite which occurs in the Devonian rocks of Belas Basin, Lepreau; several shafts have been sunk, the deepest of which in 1878 had reached 140 feet. The character, however, of the coal did not seem to improve sufficiently to warrant the investment of further capital. The large percentage of ash—36 per cent.—is strongly against the good quality of the mineral as a combustible. The bulk of the seam is carbonaceous shale. The Geological Survey Report of 1878-79 says it is exceedingly doubtful if coal of sufficient purity for marketable purposes will be obtained there. A similar deposit occurs at Clinch's post office, Musquash, but of little value.

More than a third of the province of New Brunswick is occupied by rocks of the coal formation, which present the usual variety of conglomerates, sandstone and shales met with in other coal regions, together with numerous and characteristic fossil remains. Seams of coal are also met with at various points, but, so far as at present known, are all of inconsiderable thickness, only one, that of Grand Lake, attaining a thickness (22-26 inches) sufficiently great to be capable of working. Being, however, usually nearly or quite horizontal, such beds as do occur cover considerable areas, and when sufficiently near the surface are readily removed. For the same reason but little information can be obtained from the surface as to the possible occurence of thicker beds beneath, and it is necessary to resort to borings in order to prove the latter. The results so far obtained in this direction are certainly unfavourable to the existence of any such beds or even to the probability of any great thickness to the coal formation as a whole in this region. It is possible that the carboniferous rock may at some points attain a much more considerable thickness and include workable beds of coal. The only locality in which mining operations for this mineral are at present conducted is in and about the Newcastle River and the shores of the Grand Lake, in Queens County. The beds here, having a thickness of about 2 feet are usually met with within ten or fifteen feet of the surface, and have been removed at a great number of points, over an area of over 100 square miles, indicating a total productive capacity of about 154,948,147 tons. The coal is a true bituminous coal, and is employed both for household and blacksmiths' use. As this seam is worked, and it is to be supposed profitably, by the present owners of the different mines at a number of points over the area, it may fairly be presumed that with economical management and a proper system of working a large portion of this enormous quantity might be profitably extracted. The coal is said to be of good quality

and the price of that used for house purposes at St. John varies from $5 to $8 per chaldron.

Bituminous shales are found at or near the base of the lower carboniferous formation in Albert County, and appear to be a somewhat local deposit. They are more conspicuous in the vicinity of the celebrated Albert mine, near Hillsboro', of which they form the enclosing rocks, and thence extend east and west for over 50 miles, and of a thickness as yet undetermined. These shales are of a tough, dense and fine grained character, and with a strong bituminous odour, especially when rubbed.

They are found sometimes to contain veins of albertite, as well as small quantities of petroleum.

Attempts to employ these shales for the manufacture of oils have been made at various times, and somewhat extensive works for the purpose were erected at Baltimore, a few miles distant from the Albert mines, but after several years operations were abandoned in consequence of the heavy import duties imposed upon such products in the United States, and the competition with the natural oils then being developed in that country. Their yield of oil was somewhat variable, but that of the best bed used at Baltimore was sixty-three gallons per ton. The same shales were capable of yielding 7,500 feet per ton, of gas. In the year 1865, about 2,000 tons were removed from similar beds in the county of Westmoreland, and exported to the United States, selling in that market at the rate of $6.00 per ton.

A remarkable mineral known as Albertite was first discovered by accident about the year 1850, near the town of Hillsboro', in Albert County, and has been by some regarded as a true coal, by others as a variety of jet, and by others again as more nearly related to asphaltum. It resembles the latter closely in appearance, being very black, brittle and lustrous, with a broad conchoidal fracture, and, like asphaltume, is destitute of structure, but differs in fusibility and in its relation to various solvents. From the true coal it differs in being of one quality throughout, in containing no traces of vegetable tissues, and in its mode of occurence, which is that of a *vein* and not that of a true bed. This vein occupies an irregular and nearly vertical fissure, has a varying thickness of from one inch to seventeen feet, and has been mined to a depth of 1,260 feet, and a trial hole in the western area 100 feet deeper showed the continuance of the vein. The accompanying shales are in some portions abundantly filled with the remains of fossil fishes *(Palæoniscus)*, and it is not improbable that it was from these, in part at least, that the mineral was derived, existing perahaps at first in a fluid condition (in which state it has in some instances become the cementing material of conglomerate),

and subsequently hardened into its present form. Vegetable remains are almost entirely wanting. The Albert Mine is situated in the upper part of Frederick's Brook, a branch of Weldon Creek.

Since the first discovery of the Albert mines, the amount of the mineral removed and exported has been very large, being nearly 200,000 tons. The mineral was exported to the States, partly for the manufacture of oil and partly for admixture with other coals in the preparation of illuminating gas. For either of these purposes it is admirably adapted, being capable of yielding 100 gallons of crude oil or 14,500 cubic feet of gas per ton, of superior illuminating power. When employed with other coals it also leaves as a residuum a valuable coke. The price at which it has been sold has varied at different periods from $15.00 to $20.00 (gold) per ton. The number of men at present employed in connection with the works is about 120. The freight to Boston is $2.00 or to St. John $1.00 per ton.

British Columbia.—The presence of good coal in Vancouver Island and the absence of it in other portions of the Pacific coast, are greatly in favour of this Province. "In her coal fields" says Dr. Brown, of Edinburgh, who visited that Province some years ago, "British Columbia has within herself the elements of lasting prosperity." The excellent quality of the Vancouver coal is well established, and it is in great request for gas, steam and domestic use.

The tertiary beds of inferior coal are to be found cropping out in the southern part of the west coast of Vancouver Island, and also in the northern part of the mainland.

The secondary beds of the North Pacific coast, affording very good coal, and situated so as to be more or less capable of being profitably worked, are believed to be confined to Vancouver Island.

Anthracite coal is found in Queen Charlotte Island.

The secondary beds are best represented in the coal fields of Nanaimo and Comox. The whole extent of this coal vein is estimated by the Geological Survey Reports to extend to the vicinity of Cape Mudge, in the north-west, and to approach to within 15 miles of Victoria, on the south-east, with a length of 130 miles. Nanaimo is situated on the south-east coast of Vancouver Island, near Newcastle and Protection Islands, the latter so named from the shelter afforded vessels loading there. On Newcastle Island the cliffs rise perpendicular from the water, showing several seams of clear, hard coal, partially worked, but the main works are at Nanaino, on a 6 foot and a 3 foot seam, ten miles further south and carried on by the Vancouver Island Coal Company. The colliery was first opened about 30 years ago, and yields well. Two other companies are also working known as the Wellington and Harewood. The two first carry their coal to the wharf by short railways, and

the last is provided with a tramway. The seam worked by the Wellington Company is 9 feet 6 inches thick, that at the Harewood mine being 5 to 6 feet thick. The coal sells at the mines at from $5 to $6 and realises in San Francisco $10 per ton. The production keeps fair with the demand, and the works are being freely extended in view of a growing market. The rocks accompanying the coal are sandstones, conglomerates and shale. The Nanaimo coal field has a length of about 16 miles, with an average breadth of 6 miles, and its surface would measure upwards of 90 square miles.

The Comox vein has a length of about 40 miles and 13 in its widest part, or, averaging a little over 7 miles, and the productive area may safely be considered to hold about 300 square miles. *(Geological Survey Report*, 1871-72.*)* The mines worked here are the Union, the Beauport and the Baynes Sound ; in the first of these the total thickness of workable seams is a little over 25 feet, or 16,000,000 tons per square mile. In the Baynes Sound mine about 7,680,000 tons. In the Beauport the thickness is not yet definitely ascertained.

Nanaimo and Comox are not the only known coal fields of Vancouver Island Coal occurs and was formerly worked by the Hudson Bay Company at Fort Rupert, on the north-east coast, and the seams again occur on the west coast at Quatseno Sound. An examination of the latter locality was made for an English Company, of which Dr. Brown writes, " my opinion is decided that the Korkemo (Quatseno) coal field is the best yet discovered in Vancouver Island, though unopened, not only on account of the superior quality of the coal, but the ready accessibility of the mines from the Pacific, without the tedious inland navigation requisite for reaching the mines on the eastern seaboard of the Island." The coal area here is estimated at 33,600,000 tons.

Specimens of coal have also been procured at the head of Alberni Canal, opening into Barclay Sound, on the west coast.

The tertiary rocks of the mainland of British Columbia appear to hold both true coal and brown coal or lignite, and are a continuation of the coal measures of Washington Territory. They are estimated to underlie nearly 1,000 squares miles of the low country about the estuary of the Fraser River. Lignite has been found at Burrard Inlet, and specimens resembling true bituminous coal have been found above New Westminster. The same rocks are seen near Sooke, and in various places on the south-west coast of Vancouver Island ; none of them have been particularly examined yet. In the Nicola Valley, near the junction of the Coldwater, coal has been known for some years to exist, and an analysis shows it to be of a very high class of the bituminous kind. Its chief exposure is in the west

branch of the Clearwater River. Similar rocks have been examined on the North Thompson, 45 miles above Kamloops, and found to contain coal of excellent quality, but in thin seams. Near Marble Canon a bed of lignite occurs 40 feet thick, and important deposits are met with on the North and South Forks of the Similkameen.

The occurrence of anthracite coal in the Queen Charlotte Islands has been known for a long time, and some years ago the Queen Charlotte Coal Mining Company opened mines at Cowgitz. The length of the coal bearing rocks between Cowgitz and Massett, at which latter place specimens have been obtained, is estimated at about 84 miles, but the width is not ascertained. (*Geological Survey Report*, 1872-73.) The Cowgitz Mine was worked for seven or eight years and then abandoned, too great dependence having been placed on the continuity and uniformity of the coal seams, without the necessary amount of preliminary exploration to determine these points Prof. Dawson says "the indications were not such as to justify a heavy expenditure in preparing for the shipment of coal, but quite sufficiently promising to render a careful and systematic examination of the locality desirable." The same writer remarks that the occurrence of a bed of true anthracite in rocks of cretaceous age is a matter of considerable geological interest. A seam of anthracite is reported on Skidegate Channel, 14 miles south east of Cowgitz. The anthracite of these Islands compares favourably with that from Pennsylvania, and an analysis by Dr. Hanington resulted very favourably.

The coal bearing localities of British Columbia are given in Geological Survey Report, 1876-77, as follows :—

Queen Charlotte Islands.—Cowgitz, Skidegate Channel, and Massett, at the northern end of the Islands—anthracite.

Vancouver Island.—Nanaimo, Comox, Quatseno, Fort Rupert, Alberni Canal—bituminous coal ; and north side of Cowitchin Bay, anthracite in sandstone.

Mainland of British Columbia.—Langley, Chilliwack River, Junction of Nicola and Coldwater rivers, North Thompson, Lillooet, Peace River and Pine River—bituminous coal; Coal Harbour, Ten Mile Creek, Similkameen River, Cold Spring House, Fraser River (Quesnel), Parsnip River, Nechacco, Blackwater, Chilacco, Nazco Rivers, and Punchiask Brook—lignites ; whilst at Bear River and Nasse-Skenna District, coal (not specified) is reported, the beds at the latter being from 3 to 35 feet thick.

Capital and labour are the two essentials to the almost unlimited development of coal mining in British Columbia. The existence of a fine quality of coal on the seaboard cannot fail to be of the very greatest importance when the Canadian Pacific Railway converts

British Columbia into one of the world's highways. By that time, all the trans-continental railways will connect on the Pacific coast with lines of coasting and ocean steamers, which will get steam coal from the only North Pacific district that can supply it, namely, Vancouver Island. The effect also of a supply of coal on local manufacturing industry cannot be overlooked as an element of future prosperity.

North-West Territory.—Specimens of anthracite were obtained from Long Island, near Great Whale River, on the east coast of Hudson Bay, by Professor Bell. The Indian who brought them reported plenty of it existing there. A similar mineral exists some miles inland from Little Whale River. It is probable that it does not occur as a seam of altered bituminous coal, like ordinary anthracite, but rather as resulting from hardened pitch, or a mineral like Albertite by the loss of its bitumen, and may not exist in large quantities. Bituminous limestones and carbonaceous shales exist on Abitibi River, belonging to the Devonian formation. On the Missinaibi River in this district there is a bed of lignite, and on the west bank of Coal Brook another 3 feet thick. At the mouth of Poplar River there is a bed 6 feet thick, and smaller seams exist in various parts of the same locality.

Professor Selwyn reports (*Geological Survey*, 1873-74) lignite beds at and near Rocky Mountain House, and seams cropping out between that site and Edmonton, as well as "bright jet-like brown coal." At one place 40 miles below the confluence of the Brazeau River he found a seam of this jet-like coal from 18 to 20 feet thick. He further says "there can be no question that in the region west of Edmonton, bounded on the north by the Arthabasca River and on the South by the Red Deer River, there exists a vast coal field covering an area not less than 25,000 square miles; and beneath a large portion of this area we may expect to find workable seams of coal, seldom exceeding 300 feet and often favourably situated for working by levels from the surface."

The general scarcity and low quality of the timber over hundreds of miles of country bordering the two Saskatchewan Rivers, render it a matter of the very greatest importance in connection with future settlement of the North-West, and the opening it up either by land or water steam transport to ascertain where and at what depth coal can be procured available for domestic purposes, railroads and steamboats. The universal covering of superficial deposits, the flatness of the strata, and the few points where natural exposures exist, render surface examination of little avail in solving this question, and to determine it borings must be made. The coal deposits of the north-

west are considered by Professor Selwyn to closely assimilate to those of the contiguous territories of the United States bordering the Rocky Mountains; in fact he looks upon the coal seams now being worked in those Territories as only a "southern prolongation of one vast and widespread coal bearing formation extending from the shores of the Arctic ocean for thousands of miles along the eastern slope of the Rocky Mountains." Existing in sandstones and fire clays, they are probably of the lower tertiary age, and, to use the words of a report of Professor Hodge, "they are entitled to an appropriate name that should distinguish them not merely from the common bituminous coal but from lignites also, to which they bear still less resemblance."

The recent discovery of coal in the Souris district will prove of incalculable value to Manitoba and the country surrounding, and should the quality turn out equal to what is expected for steam purposes it will be one of the most valuable adjuncts to the prosperity and progress of the North-West.

SALT.

Ontario.—Boring operations in search of petroleum at Goderich resulted in the discovery of a bed of rock salt 30 feet thick at a depth of 964 feet, and the boring being extended to a depth of 1,010 feet, when hard rock was met with, yielded by pumping a very pure saturated brine. Further investigations were made in the vicinity, and the fact was established that a large salt bearing basin existed in the locality, which could be profitably worked.

The salina formation of New York State crosses Niagara River above the Falls and enters Ontario, where it has been traced westward to Brantford; thence north-east to Southampton, at the mouth of the Saugeen River, Lake Huron; stretching thence to Goderich, where the higher beds of the series disappear. Passing thence beneath Lake Huron the outcrop reappears in Duck Islands and at the Straits of Mackinaw. The belt of this series varies in breadth from 8 to 16 miles. A number of wells have been sunk at Goderich. At Kincardine, 30 miles north-east, salt is found at 900 feet. At Kingstone's Mills, in Warwick, 50 miles south-west of Goderich, salt is found at 1,200 feet. The principal wells, however, are those of Goderich, Clinton, Seaforth and Kincardine, the brine of great strength, varying, according to Dr. Sterry Hunt, from 90 to 100 per cent., and the manufacture of salt by artificial heat is carried on by all of them, a large portion of the manufactured article being shipped to the United States.

Quebec.—The only evidences of saline matter in this Province are such as are afforded by saline or mineral springs scattered through various points.

Nova Scotia.—Salt is found in crystals in many of the gypsum quarries of this Province, and springs holding large quantities of it issue from their vicinity. No systematic test has ever yet been made of the gypsum mines there at a proper depth from the surface, and the subject is one worthy of serious attention. Salt has, however, been made at various times from its brine springs, and in some cases a superior quality was produced, but at present very little is done. Among the various springs the best known are those of Renfrew, Walton, Salt Springs and Irish Mountain, Pictou County; Sutherland's River, Antigonish; Ohio, Baddeck, Whyhogomah, River Philip and Black Brook, Cumberland County. At the last named locality salt is manufactured by the Messrs. Gilroy, and is suitable for domestic use.

Mr. Roll reports the water of several springs on the north side of the Little Narrows of Bras d'Or Lake, 12 miles south-west of Baddeck, yields from two to three bushels of salt to six gallons by evaporation, and that vegetation is destroyed around the springs. They issue from rocks lying at the base of the lower carboniferous formation, and much proxide of iron is deposited in the water which comes from them.

North-West Territory.—Professor Selwyn mentions several shallow saline lakes east of Pine Creek, 17 miles from the Little Saskatchewan, where the road from Prairie Portage, *via* the White Mud River, comes in. These lakes were easily distinguishable from those holding fresh water by being fringed with samphire, *salicornia*. At File Hills the same water was met with, and descending from Touchwood Hills stretches out the great salt plain full of saline lakes; these are four or five miles long and occasionally from one to two miles wide. This plateau forms the watershed between the Qu'Appelle to the south-west and Saskatchewan and Assiniboine to the north-east. Near the head of Woody Mountains and Dirt Hills are two saline lakes, the bed of one of which was covered with white salt when visited by Professor Bell. Alkaline springs were noticed by Professor Macoun on the Lower Peace and Athabasca River, and he states that all the salt used on both the Peace and Mackenzie Rivers is obtained at Salt River, a considerable stream emptying into Slave River 100 miles below Fort Chippenyan. Some distance up this river a number of brine springs are scattered over a wide plain, and around these large accumulations of excel-

lent salt are deposited. The Hudson Bay Company send a boat there every autumn, and the finest of the salt is shovelled into sacks and brought away. Professor Macoun says: "Men who have been there told me that the *salt is of unknown depth and extent*, and it is supposed that there are vast deposits at an inconsiderable depth below the surface." Another salt region, which takes half a day to cross, is reported at about midway on the portage between Great Slave and Great Bear Lakes. Near Clearwater Lake salt springs were met with by the same explorer, which he says "possess a very strong brine."

British Columbia.—Mention is made in the Geological Survey Reports, 1875-76, of nitre in the form of a white granular powder existing in calcareous tufa on the Chilcotin and Nazco rivers; analysed by Mr. Hoffman it was found to consist of potassic nitrate, with nitrate of soda and traces of sulphate and chloride. Admiral or Salt Spring Island, on the south-west side of Shoal Bay, Vancouver Island, possesses several salt springs, giving it one of the names by which it is known. The water is said by Mr. Forbes, quoting from Mr. Pemberton, to contain 3,446 grains of salt to the Imperial gallon. Little is known, however, respecting its capabilities for use.

PETROLEUM.

This mineral product, known also as kerosene, or coal oil, affords a trade which ranks amongst the foremost of Canadian industries, employing capital to the extent of at least $10,000,000. The home consumption alone is estimated at upwards of 6,000,000 gallons.

Ontario.—The region in this Province where crude petroleum has been and is obtained is of considerable area, the section principally worked being the westerly part of the Province. Bothwell, in the county of Kent, and Enniskillen and Petrolia, in Lambton, are the largest oil producing districts, where it is obtained at a depth of from 400 to 500 feet. The formation in which it is found is a carboniferous limestone overlaid by clays and gravels, which latter also hold the oil rising from the limestone. A petroleum spring exists in the Manitoulin Islands, on Lake Huron, rising from the Utica limestone; this, however, is not utilized.

Quebec.—In the vicinity of Gaspé petroleum has been observed rising from the Devonian rocks. Near Douglastown a petroleum spring

oozes from the mud and shingle of the beach and is seen in globules rising through the water at high tide, and has given the name of Tar Point to a headland near by. Another similar spring exists on Silver Brook, a tributary of the South-West Arm, near Gaspé Basin. The oil here collects on the surface of pools as a thick film. Several other localities in the vicinity of Gaspé Basin yield this product. Borings have been made, but nothing has yet been done in the way of establishing works. Sir William Logan speaks of the indications of oil as interesting as showing the existence of oil over a considerable area in this region, some part of which he says may perhaps furnish available quantities of this material. At Riviére a la Rose, Montmorenci, petroleum exudes in drops from fossil corals, probably derived from organic remains.—(*Geology of Canada, p.* 521.)

New Brunswick.—Fluid petroleum, besides the oil extracted from the shales alluded to already under the heading Coal, has been observed at the Albert mines, Upper Hillsboro, Beliveau, Memramcook and Dover. The Albert shales in all these instances appear to be its source. At Dover it rises to the surface in connection with ordinary springs. It is especially abundant in the sandstones overlying the shales, and it is from these, if anywhere, that it is likely to be obtained in available quantities.—(*Geological Survey Report,* 1876-77.) Several attempts have been made in this direction, but the flow was small. The strata in question are at many points saturated with oil. Further experiments in this locality might reasonably be expected to prove favourable.

Nova Scotia.—The Inspector of Mines in this Province states in his latest report that the lower carboniferous measures of Nova Scotia have been so much disturbed and metamorphosed that a yield of oil is problematical. Indications of it have been observed at Cheverie, Hants County, permeating the gypsum and limestone of that locality. At Lake Ainslie, Cape Breton, it has been noticed in similar strata and numerous attempts have been made to strike it by boring, but so far unsuccessfully. Practical oil men have pronounced the signs as indicative of extensive deposits, and experimenting is in progress to ascertain if success cannot be obtained in developing it.

North-West Territory.—Professor Macoun mentions a tar conglomerate seen by him at Poplar Point, on Athabasca River, with

sand above and below it, and the ooze along the shore at this point and many places below it looked like the ooze from petroleum springs. The tar conglomerate, he says, was frequently observed as he proceeded up the river, sometimes forming a bed ten feet thick.

British Columbia.—Petroleum is not alluded to in the Geological Survey Reports on this Province, though the bituminous shales overlying its coal may hold it.

OTHER MINERALS.

Materials for building, flagging, paving and slating are abundant throughout the Dominion, of which granite, sandstone and limestone are among the most prominent. It is needless to detail their localities in each Province, as all possess more or less of these materials. Limestone for common lime is largely found, as well as a material applicable to making water lime, or hydraulic cement. Sandstone suitable for grindstones, though not of the best quality, is obtained, and materials applicable for whetstones and hones are freely found. Materials adapted for millstones is met with among the granites. Marble of various qualities is found in many localities and of varied character—white, black, brown, grey, mottled, variegated, spotted and green. Lithographic stone of good quality is obtainable. Materials exist for glass making, viz: white quartz and silicious sandstone, and basalt for black glass. Kaolin for porcelain is met with, though rare. Soapstone, emery and infusorial earths are found and utilized. Bathbricks for knife polishing are manufactured in the County of Bruce, Ontario, and Professor Chapman says they "compare favourably with the bathbrick of England, and especially useful for scouring purposes." Precious stones are not wanting to close the list, amongst which may be mentioned the agates, jaspar and amethysts of Lake Superior, the latter remarkable for their beauty, and specimens from Nova Scotia are much admired in Europe. The early French settlers sent considerable quantities home, and one very handsome amethyst was divided into two and placed in the crown of one of the French Kings. Garnets are common in the gold districts associated with the rocks holding that metal. A topaz said to have come from Cape Breton was shown at the exhibition in London in 1872. Rock crystal is common in the older rocks. Bloodstone is met with on Lake Superior and opal occasionally in the trap rock of Nova Scotia.

PRINCE EDWARD ISLAND.

No minerals have yet been discovered in this Province in sufficient quantities to be of economic importance. The prevailing rock is a reddish sandstone, but a large part of the surface is alluvial, and entirely free from stone. The only minerals as yet known there are as follows :—

Iron.—Red hematite in concretions at Gallas Point and vicinity. Sufficient might be gathered on the beach to afford a small additional supply to an iron furnace, but not to warrant any independent enterprise. Bog iron is occasionally found in swamps.

Copper.—Grey sulphide occurs in concretions in a sandstone at Governor's Island, associated with green carbonate, but in inconsiderable quantities.

Manganese.—This occurs in concretions like bog iron in swamps in different parts of the island, but not in any quantity to render it of importance.

No other minerals are known in Prince Edward Island. Building and limestones are found and there are large deposits of peat.

PRODUCTS OF THE MINE, 1881.

The following table, taken from the Trade and Navigation Returns for 1880-81, shows the exports of produce of the mines in Canada for that year :—

	Value.
420,055 tons of Coal	$1,123,091
130,961 " Gypsum	119,399
46 " Antimony	3,921
19,802 " Copper	150,412
44,677 " Iron	114,850
2,101 " Manganese	38,738
15,601 " Phosphates	239,493
Gold bearing Quartz	767,318
Silver	34,494
Petroleum (refined)	631
Salt, 253,555 bushels	39,566

CONCLUSION.

The short description in the above pages of the minerals of the Dominion, and their localities by provinces, will show the most casual reader that Canada possesses wealth enough below the soil to enrich not only its own population but all who may join with us in disinterring this wealth. Capital only is necessary in most cases to make mining productive. As the mineral resources become developed, the agricultural capabilites must in due course be stimulated, manufactures and commerce spring up, and a numerous and thriving population gain their living by an industry as yet only in its infancy in the DOMINION OF CANADA.

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